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THE VIRGINIA JOURNAL OF SCIENCE

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MARCELLUS HENRY STOW 1902-1957

Marcellus H. Stow, Robinson professor of geology, professor on the Thomas Ball Foundation, and head of the Department of Geology at Washington and Lee University since 1937, died at his home Wednesday, November 27, 1957. In his passing, Virginia lost one of its most energetic and capable scientists.

Dr. Stow took all of his collegiate and graduate work at Cornell University where he obtained his Ph.D. degree in 1926. In 1927, he joined the staff of the Department of Geology at Washington and Lee University, where he rose through the academic ranks to succeed the late Dr. H. D. Campbell as head of the Department of Geology in 1937.

Stow made extensive studies of the Oriskany sandstone and published several excellent papers dealing with the sedimentary environment and provenance of the formation. His specialty was heavy-mineral petrography. Beginning in the summer of 1933 he conducted field geological studies and research with the Yellowstone-Big Horn Research Association which continued for several summers thereafter. He applied the methods of heavy-mineral petrography to a study of the sedimentation, volcanism, and orogeny in the Big Horn Basin and Beartooth Mountains, which was published in the Geological Society of America, Bulletin, in 1937, 1938, and 1947. He is credited with the recognition and correct interpretation of the Fincastle conglomerate, which has figured prominently in recent reinterpretations of the geologic history of the Appalachian geosyncline.

From 1942-45 he served as a deputy director of the mining division of the War Production Board. Late in 1945 he became chief of the mining branch of the Civilian Production Administration. He had been a member of the Governor's Advisory Council on Virginia Economy since 1948 and was chairman of the committee on mining in 1948-49. In 1953-54 he served as chairman of the Governor's Advisory Committee on Geology and later served as special geological consultant to the director of the Department of Conservation and Development. Also for several years, he served as a geological consultant to the Atomic Energy Commission and made extensive surveys for uranium minerals in the southeastern states. He was chairman of the James River Monograph Committee and editor-in-charge of the Virginia Academy of Science's "James

River: Past, Present, and Future" which was published by the Academy in 1950. Dr. Stow was also active in other affairs of the Virginia Academy of Science, holding offices as council member from 1939-1946 and as president of the Academy 1942-1943. For many years he served as a member of the Advisory Board of the Virginia Fisheries Laboratory, the Virginia State Museum Commission, and with various committees of the Southern Association of Science and Industry. He served as a member of the Board of Directors of the Southern Research Institute since 1945. He was also a Fellow of the Geological Society of America and a member of the Society of Economic Geologists and Paleontologists, Sigma Xi, Phi Kappa Phi, Sigma Gamma Epsilon, Sigma Phi Epsilon, and Phi Beta Kappa. He received a War Department citation in December, 1945 for his work with the War Production Board. He was a member of the Cosmos Club. He also served as contributing editor to *The Commonwealth,* published by the Virginia Chamber of Commerce.

The Department of Geology at Washington and Lee University, under his direction, developed into one of the outstanding undergraduate departments of geology in the southeastern United States. Dr. Stow's advanced students were always in attendance at the annual meetings of the Geology Section of the Virginia Academy of Science where nearly every year one or more of them presented a paper on work done on some phase of Virginia geology, studied under the direction of their able mentor. His service on numerous university committees made him one of the most valuable members of the Washington and Lee faculty.

"Mar" had an unusual facility for working with people. His quiet, easy-going, jovial manner was blended with wisdom, energy and prodigious drive. All these qualities he poured into his academic and professional activities with outstanding results. He was widely sought after by government and scientific groups working on improvement of the economic conditions in Virginia and the South. His activities were invariably characterized by fairness, patience, and sound judgment. Virginia has lost a valuable liaison between science and government. Not all of the outstanding contributions Stow made to State government are well known to his fellow scientists, but many of his special assignments required qualities which would have exhausted the patience and forbearance of a lesser man. Among his most recent publications was "The Mineral Resources and Mineral Industry of Virginia," a summary report of the Committee on Mining of the Advisory Council on the Virginia Economy, of which he was chairman in 1948-49.

The loss we have sustained in losing "Mar" in the very prime of life is indeed a heavy one. But life need not be long to be rich and full. As measured not in years but in accomplishment "Mar" lived a full, valuable, dedicated life of service.

—Byron Cooper, *Virginia Polytechnic Institute.*

A Review Of The Anoetidae (Acari)

Roscoe D. Hughes
and
Caroline Goode Jackson
Medical College of Virginia

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The authors are greatly indebted to Miss Jane Boyd Lee and Mrs. Ruth Morrissey Bane for technical aid and for assistance in the preparation of the manuscript; to students and others whose names appear in the text for collecting a number of species of anoetids; and especially to Dr. Edward W. Baker for his invaluable advice during the course of this study and for reading the manuscript. The publication of this paper has been made possible by generous financial support from the Adora Wardell Sexton Foundation, Inc., A. D. Williams Research Fund of the Medical College of Virginia, and the Richmond Area University Center. The authors also wish to acknowledge their indebtedness to Dr. L. van der Hammen, Rijksmuseum van Natuurlijke Historie, Leiden for permission to use a number of A. C. Oudemans, hitherto unpublished drawings.

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INTRODUCTION

Not since the publication of Michael's "British Tryoglyphidae" (1901-1902) has there been an attempt to review the taxonomy and biology of the family Anoetidae.* A critical review is desirable and urgent for the reason that some of the more recent taxonomic papers, as well as many of the older ones, are so lacking in essential details that taxonomic confusion in this family prevails. This study has inevitably brought to light certain taxonomic categories of dubious validity. However, we take the view that so few of the potentially large number of species in the Anoetidae have been described that we do not as yet have a sufficiently large sample upon which a logical, complete revision can be based. Accordingly, we have deliberately refrained from attempting major revisional changes at this time.

Our interest in the Anoetidae is not purely taxonomic. Their ease of culture under laboratory conditions, relatively short life cycle, world wide distribution, omnipresence in a variety of habitats, small numbers of chromosomes, and enormous potential number of species are some of the factors which make them ideal material for problems in speciation. Parthenogenesis appears to be typical for this group, yet in at least one species pseudofertilization, or insemination seems to be necessary to initiate development of male producing eggs. However, the sex ratio obtained in this instance suggests that we are not dealing with a typical bisexual species. The remaining species so far examined fall into two distinct parthenogenetic groups, namely: arrhenotokous species, and thelytokous species. Since arrhenotoky and thelytoky are considered to involve quite different cytogenetic mechanisms, their occurrence in the same family is unusual though not unique. If typical bisexual species are later found in this family, as has been reported for some families of mites, the Anoetidae would indeed be remarkable for its reproductive plasticity. The evolution of parthenogenesis in this family and the elucidation of the mode, or modes of sex determination, also pose problems of great interest.

MATERIALS AND METHODS

Preparation of specimens for study. — The most satisfactory slides for study are made of specimens first cleared by a method described by H. H. Keifer (1935) and then mounted in Hoyer's medium. (Baker and Wharton, 1952).

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*Attention is invited to a comprehensive study of German Anoetidae by Dr. Rita Scheucher which was published while our paper was in press. (See addendum to Bibliography).

Keifer's clearing agent

Melted phenol	4 cc.
Lactic acid solution	12 cc.
Resorcinol	1/2 gm. (or less)
Potassium iodide	1/2 gm.
Hydrochloric acid solution conc.	16 drops

Anoetids tend to accumulate a large number of crystals, or pseudo-crystals (see below) in body spaces which render them opaque, and obscure the finer cuticular details. Keifer's clearing agent readily takes care of this problem. Two or three drops of clearing solution are placed on the end of a clean slide. One or many living mites are transferred to the medium. The slide is passed over a low flame and gently heated for 1-2 minutes, or until the mites are cleared. A drop of Hoyer's mounting medium is added to the middle of the slide and the mites transferred directly to this from the clearing medium with needles, and a cover slip added. Gentle pressure on the cover slip at this time will aid in orienting mites as desired, and extending the appendages. The cuticle of freshly prepared specimens is slightly yellow. Critical study of faint apodemata, and minute setae is best undertaken with fresh slides. However, specimens prepared as above remain in excellent condition indefinitely although gradually becoming quite transparent. It is often desirable to study living specimens in order to distinguish between movable and incipient joints of appendages, observe the functioning of mouth parts and suckers, determine the arrangement of minute setae, and to make other observations which are facilitated by movement, or change of position. An aqueous solution of methocellulose (Methocel) is excellent for this purpose. Living specimens mounted in this solution can be studied with an oil immersion lens, or lower power, for a considerable period.

Methods of collection. — Since anoetids are likely to be found wherever there are fermenting organic compounds, one satisfactory way of collecting is simply to examine bits of organic material under a hand lens and preserve any mites found in 70% alcohol, or inoculate culture media with specimens for future study in the laboratory. A much preferred method of collection is by trapping. Old milk bottles, containing a suitable culture medium, and partially closed by a cap with a small segment removed in order to allow the entrance of insects but prevent the entrance of mice, are quite suitable. The traps should be smeared with over ripe bananas, or other actively fermenting materials to attract insects and other small invertebrates. In this way any deutonymphs which are attached to insects and other animals entering the traps, and possibly originating from distant sources and varied ecological niches, may be induced to detach from their hosts, and metamorphose into trophic tri-

tonymphs. A new colony may be started by a single individual if the resulting adult is a parthenogenetic female, and if the culture medium is suitable. Trap bottles are firmly plugged with cotton before bringing to the laboratory, where they are examined periodically, and are discarded in 3-5 weeks if no mites can be seen. The most effective traps appear to be those placed on the ground in damp woods, compost piles, near decaying logs, and orchards. Those suspended from tree branches are nearly as effective. Traps should not be placed in full sunlight, and should be so inclined that they will not collect rain water.

Culture technique and media. – Nearly all species of the Anoetidae so far encountered are easily cultured in a wide variety of media. They appear to thrive best when fermentation of organic matter is evident. Anoetids are surface feeders, and most seem to prefer a thin film of fluid in which to wade while feeding. It is presumed that they engulf yeasts, and other microorganisms. Most species thrive in the laboratory on standard cornmeal – molasses – agar medium or stable fly medium to which wood shavings have been added, or a combination of both.

Cornmeal – molasses – agar medium. –

Water	931 cc.
Agar	19 gm.
Molasses	169 cc.
Cornmeal	125 gm.
Moldex (10% in 70% alcohol)	9 cc.

Stable fly medium. –

Standard N.A.I.D.M. Peet-Grady media	600 gm.
Shavings	300 gm.
Agar	100 gm.
Water	4500 cc.
Moldex (10% in 70% alcohol)	50 cc.

About 100 ml. of medium is placed in 250 ml. Erlenmeyer flasks and tightly plugged with absorbent cotton wrapped in gauze. In order to provide a tight plug seal, the inside of the flask neck is smeared with vaseline. Contamination of stocks can be a problem, hence sterile procedures are necessary for maintaining species purity. In making new stocks a bit of food containing mites from old stocks is transferred to the new medium. Most species require a change of culture medium every 3-6 weeks.

TAXONOMIC POSITION OF THE FAMILY ANOETIDAE (Oudemans, 1904)

The Anoetidae is a family under the superfamily Anoetoidea, suborder Sarcoptiformes of the order Acarina.

DIAGNOSIS OF THE FAMILY ANOETIDAE

(Plates 1-12)

Free living, rarely parasitic; terrestrial, usually on decaying organic matter, rarely water dwelling; soft-bodied; whitish, opaque; dorsum smooth, pitted, or sculptured; venter typically smooth; dorsal suture between propodosoma and metapodosoma more or less distinct; dorsal idiosoma of adults occasionally with prominent protuberances; with dorsal opisthosomatic bursa copulatrix; adults with one pair of opisthosomatic "oil glands;" females with transverse genital slit; adults with two pairs of ringlike structures, typically without true anal or genital suckers; deutonymph with one pair of suckers and one to three pairs of sucker-like discs on suctorial plate; crystals or pseudocrystals in body cavity; no stigmata or tracheae, but adults with minute cuticular pit-like structures; with movable gnathosoma; chelicerae dentate, rarely simple, and functionally non-chelate, but bearing a median chelicercal process which may represent the vestige of the movable portion of a true chela; pedipalpi with two distinct simple, usually flagellum-like setae. Setae simple, dorsal setae rarely pilose; chemo-sense organ legs I-II (seta *tal*); legs I-II with atypical, non-tapering setae *(g3)* with rounded end; claws strong, typically curved, and sessile (Plates 3, 5).

It will be noted below that the genera of this family are established solely on the characteristics of the deutonymphs (hypopi). The reason for this is partly historical, since in a large percentage of the described species only the deutonymphs are known. The morphology of the adults of species which have been adequately described show no clear cut characters which permit their separation into groups corresponding to the genera based on deutonymphs. At the present it is not feasible to separate the various species into genera on the basis of the adult charateristics. The adults of one genus (based on the deutonymphs) do not show obvious common charactersitics which differ from the species of other genera. The use of adult characteristics in the establishment of genera must await a description of a larger sample of anoetids.

KEY TO THE GENERA OF THE FAMILY ANOETIDAE — BASED ON DEUTONYMPHS (HYPOPI)

1. Suctorial plate with 3 pairs of discs or suckers of equal size .... *Sellea*
   Suctorial plate with more or less than 3 pairs of discs or suckers 2
2. A terminal tarsal seta on legs I-IV conspicuously flattened and spoon-shaped ..... *Lipstorpia*
   No spoon-shaped terminal tarsal seta on leg IV 3

3. With divided claw on legs I-III ..... *Myianoetus*
   Without divided claw on legs I-III 4
4. Setae or discs on coxae I and/or III 5
   No setae or discs on Coxae I and/or III 7
5. Setae on coxae I and/or III 6
   Discs on coxae I and/or III 9
6. Large seta on coxa I, no seta on coxa III ..... *Chiropteranoetus*
   Minute or hairlike setae on coxae I and III 10
7. No seta *vm1* laterad or mesiad of coxa IV disc *di3* ..... *Anoetostoma*
   With seta *vm1* laterad or mesiad of coxa IV disc *di3* 8
8. With seta *vm1* laterad of coxa IV disc *di3* ..... *Zwickia*
   With seta *vm1* mesiad of coxa IV disc *di3* ..... *Mauduytia*
9. Disc *di1* on coxa I and *di2* on coxa III 11
   Disc on coxa I or III 10
10. Disc on coxa I only ..... *Anoetoglyphus*
    Disc on coxa III only ..... *Glyphanoetus*
11. Median disc *pd1* of suctorial plate larger than other plate discs *pd2* and *pd3* ..... *Histiostoma*
    All discs of suctorial plate, *pd1, pd2, pd3* equal in size *Prowichmannia*
12. Hairlike seta on coxae I, III, and IV; with "eyes" on anterio-lateral margin of hysterosoma ..... *Bonomoia*
    Minute seta on coxae I, III, and coxa IV mesiad of disc *di3;* no "eyes" ..... *Anoetus*

DESCRIPTION AND BIOLOGY OF A TYPICAL SPECIES

Histiostoma julorum (Koch), 1841

(Plates 1-13)

Hypopus julorum Koch, 1841; *Anoetus julorum* (Koch), 1841 [Vitzthum, 1929]; *Uropoda julorum* (Koch), 1841 [*Dujardin*, 1849a]; *Histiostoma julorum* (Koch), 1841 [Oudemans, 1937]; *Hypopus ovalis* Gervais, 1844; *Histiostoma gervaisi* (Gervais), 1844 [Oudemans, 1937]; *Hypopus vulpis* Dujardin, 1849; *Histiostoma vulpis* (Dujardin), 1849 [Oudemans, 1937]; *Anoetus sumatrensis* Oudemans, 1903.

H. julorum has been selected for detailed study because its morphology, habitat, nutritional requirements, and life cycle are rather typical of the family Anoetidae. In addition, it is widely distributed and is easily collected in the warmer seasons of the year.

DESCRIPTION OF FEMALE

General features (Plates 1-3). — Average length 0.435 mm.; aver-

age width 0.275 mm. Body pear-shaped, especially when gravid; whitish; semi-transparent; smooth, except for rostrum, which is faintly granular and slightly sculptured. Body spaces contain crystals, or pseudo-crystals, of characteristic shape and sometimes numerous enough to render the body virtually opaque. (Plate 4).

Gnathosoma (Plate 4). — The gnathosoma is directed anteriad and ventrad when in the feeding position and is partially obscured by the rostrum dorsally. The chelicerae are long, attenuated, sub-chelate, and each bears approximately twelve, nearly equal, fine teeth distally. Proximad and mesiad of the toothed region, a frayed cheliceral process is seen. Proximad and laterad of the toothed region, is also seen a thin whiplike cheliceral flagellum slightly longer than the toothed region. These processes together with the toothed distal portions of the chelicerae appear to serve as rakers when the animal is feeding. Several other fine processes are associated with the chelicerae at their bases. These extend to a position laterad of the heavily sclerotized hypopharynx. The two jointed pedipalps bear two conspicious setae distally. The anterior setae *pp1* are long and whip-like and extend laterally and caudally. The posterior setae *pp2* are very fine, about one-third the length of the anterior setae, and are directed caudally. Three extremely minute spicules can be seen under favorable conditions on the dorsal surface of the distal joint of the pedipalps. A membranous sheath partially surrounds the base of the distal joint. A pair of sub-oral setae *pp3* are located ventrally on the proximal joint of the pedipalps. The proximal joint of the pedipalps extends anteriorly to form a trowel-shaped structure on the mesial surface. The funnel-shaped opening to the gut can be seen at the base of the hypopharynx under favorable conditions. A thin, membranous structure extends anteriorly from the region of the base of the hypopharynx to the middle of the first pedipalpal joint, which is provisionally called the labium.

Venter.—Propodosoma.—The posterior limits of the gnathosoma and anterior limits of the propodosoma are marked by apodemata *a1*. Apodemata *a1* join in the midline to form a short sternum. Apodemata *a2* and *a3* join mesially to form the limits of coxae I and II. Ventrally, the phopodosoma bears a single pair of coxal setal *vp1*, about the same length as seta *pp3*. The genital opening is a wide transverse slit situated on a line connecting apodemata *a4*. It is distensible and appears to open in a ventral direction and is supported by a structure appearing as a faint longitudinal crease in the midline. The genital opening marks the posterior limit of the popodosoma on the ventral surface. *Metapodosoma.* — A line connecting apodemata *a8* marks the posterior limits of the metapodosoma on the ventral surface. The metapodosoma bears two pairs of conspicuous ringlike structures *r1* and *r2*. The anterior pair of ringlike structures *r1* is in a lateral position between apodemata *a4* and *a5*, and each is more or less elliptical in shape. Each of the posterior pair is almost circular, but some-

times appearing oval in shape, is more mesiad in position and lies on a line between coxae IV. Ventrally the metapodosoma bears three pairs of setae, as follows: one pair of paragenital setae *vm1*, near the mesial end of apodemata *a5;* one pair of coxal III setae *vm2*, directly below setae *vm1;* and one pair of coxal setae *vm3* posteriad and laterad of the posterior ringlike structures *r2*, and mesiad of coxae IV. *Opisthosoma.* — Ventrally the opisthosoma bears three pairs of setae as follows: anterior anal *vo1* very minute and in a position close to the antero-lateral margin of the anus; middle anal *vo2* about the same length as *vm3* and in a position laterad of, and on a line with, the posterior margin of the anus; posterior anal *vo3* mesiad and posteriad of *vo2*, and about twice their length. The anus is a conspicuous longitudinal slit lying in the midline of the ventral surface of the opisthosoma. A pair of minute pit-like strucutres *vpi1* are found at the extreme margin of the opisthosoma laterad and posteriad of *vo3*,

Dorsum: *Propodosoma.* — The propodosoma bears four pairs of setae, as follows: rostal *dp1;* cervical *dp2;* inner propodosomatic *dp3;* and outer propodosomatic *dp4*. Seta *dp3* is slightly shorter than *dp4* and about half again as long as seta *dp2*. Seta *dp1* is equal in length to *dp2* and, as Nesbitt (1954) has pointed out for members of the Acaridae, they do not appear to be typical setae. These seem to be more like extensions of the rostral cuticle and lack the rounded bases of regular setae. *Metapodosoma.* — Dorsally the metapodosoma is delimited anteriorly by a faint but definite sulcus and posteriorly by a line connecting apodemata *a8* projected to the dorsal surface. The metapodosoma bears five pairs of setae on the dorsal surface about half again as long as setae *dp3*, as follows: *dm1* mesiad in position; *dm2* sub-marginal in position and laterad and anteriad of *dm1;* *dm3* sub-marginal in position and laterad of *dm2;* and *dm5* marginal in position and at the level of trochanters IV. A pair of minute imperforate pits, or pore-like structures *dpi1*, are found posteriad of *dm3*. These pits are suggestive of vestigial respiratory pores, or possibly the bases of setae which have been lost, as Nesbitt (1954) has suggested.

Opisthosoma. — The dorsal surface of the opisthosoma bears seven pairs of prominent setae of approximately equal size and having a length equal to *dm1*, as follows: *do1* mesiad and laterad of excretory pore; *do2* is in a position slightly anteriad and laterad of *do1;* *do3* is sub-marginal and in a position posteriad and laterad of *do2;* *do4* near the posterior end of the opisthosoma and mesiad in position; *do5* slightly anteriad and laterad of *do4;* *do6* posteriad and laterad of *do5;* *do7* on the margin of the opisthosoma and slightly posteriad and laterad of *do4*. Dorsally the opisthosoma bears three pairs of pit-like structures, as follows: *dpi2* posteriad and laterad of seta *do2;* *dpi3* mesiad of seta *do3;* *dpi4* posteriad of seta *do3*. A pair of so-called excretory pores ("oil glands") lie in a position between *do1* and *do2*. Beneath these conspicious raised pores can be seen

a clear vesicle. The bursa copulatrix lies in the mid-line on a level with seta *do5*. Details of this structure are shown in Plate 2.

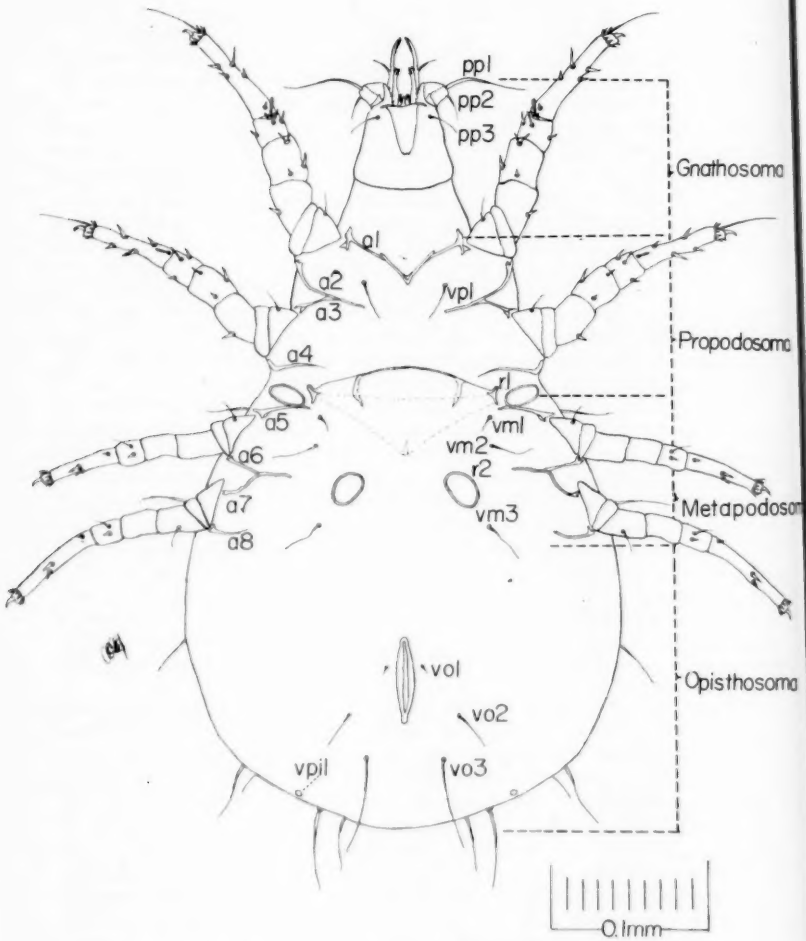

Plate 1 — *Histiostoma julorum* female. Ventral view.

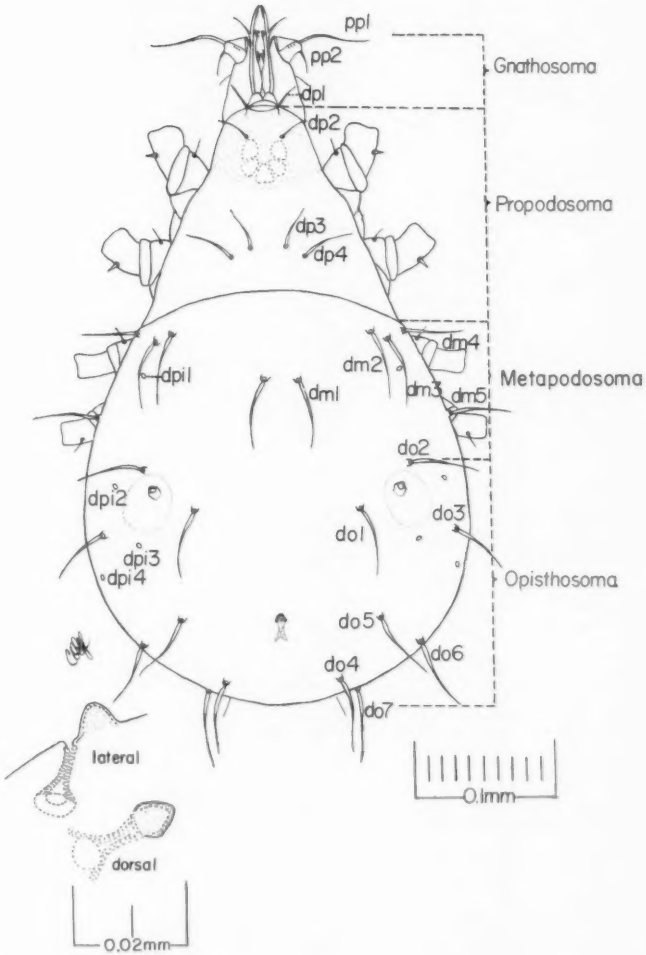

Plate 2 – *Histiostoma julorum* female. Dorsal view. Lower left, bursa copulatrix.

Legs: (Plates 1,3). *Leg I.* – The first leg is the most massive of the four legs. It bears many setae of various sizes and shapes, as follows: *coxa* – seta on ventral surface and previously described under the propodosoma *vp1; trochanter* – one thin seta *t; femur* – one spine-like seta *f; genu* – two spine-like setae *g1* and *g2*, and a pair originating from the same base, with rounded tips, and probably function as micro-sensory organs *g3* and *g4; tibia* – three spine-like setae *ti1*, *ti2*, and *ti3; tarsus*– a striated, club-shaped, macro-sense organ *ta1*, and micro-sense organ *ta2* with a rounded tip and arising from the same base as *ta1;* proximal spine-like setae *ta3* and *ta4;* median spine-like setae *ta5*, *ta6*, and *ta7;* seven spine-like setae surrounding claw – setae *ta8*, *ta9*, *ta10*, *ta11*, *ta12*, *ta13*, and *ta14;* a thin seta with a rounded end *ta15*, and a whip-like seta *ta16*. *Leg II.* – Leg II bears the following setae; *coxa* – appears to be no setae, except possibly the paragenital seta *vm1*, which may represent a coxal seta displaced posteriorly; *trochanter* – a thin hairlike seta *t; femur*– a spine-like seta *f; genu* – two spine-like setae *g1* and *g2;* a micro-sense organ with a rounded tip *g3*, similar in appearance to *g3* on leg I; *tibia*– three spine-like setae *ti1*, *ti2*, and *ti3; tarsus*– has apparent counterparts of all tarsus I setae except those corresponding to I-*ta2*, I-*ta3*, and I-*ta15*. *Leg III.* – The number of setae of this leg is still further reduced as compared with leg II. These setae are as follows: *coxa–seta vm2; trochanter*– one long seta *t; femur* – no setate; *genu* – no setae; *tibia*–seta apparently corresponding to I-*ti2* missing; *tarsus*– by comparison with tarsus I, *ta1*, *ta2*, *ta3*, *ta6*, *ta15*, and *ta16* are missing. *Leg IV.* – This leg has the same number of setae as leg III but the arrangement is slightly different. *Coxa*-seta *vm3; trochanter*– no setae; *femur*– seta *f; genu*– no setae; *tibia*– by comparison with leg I, seta *ti2* missing; *tarsus*– by comparison with leg I, seta *ta1*, *ta2*, *ta3*, *ta6*, *ta15*, and *ta16* are missing. *Claws.* – Claws of all legs spine-like, slightly curved, and equal in size.

DESCRIPTION OF MALE

General features. – (Plates 4, 5). Average length 0.320 mm.; average width 0.165 mm. The male is conspicuously smaller than the female primarily because of the reduced size of the hysterosoma. Hence, the body is more rectangular than pear-shaped. Crystals or pseudo-crystals are present as in the female. Unlike the female the rostrum of the male does not appear to be sculptured or granular and the hysterosoma has several pairs of more or less conspicuous bosses.

Gnathosoma. – There are no differences between the gnathosoma of the male and female worthy of note.

Venter: *Propodosoma.* – Ventrally the number and arrangement of the setae and apodemata are the same as for the female, except apode-

mata *a2* and *a3* after uniting continue and almost meet in mid-line. Also unlike the female, apodemata *a4* and *a5* unite and continue toward the mid-line. *Metapodosoma.* — Ventrally there are four round, or almost round ringlike structures *r1* and *r2* corresponding to similar structures in

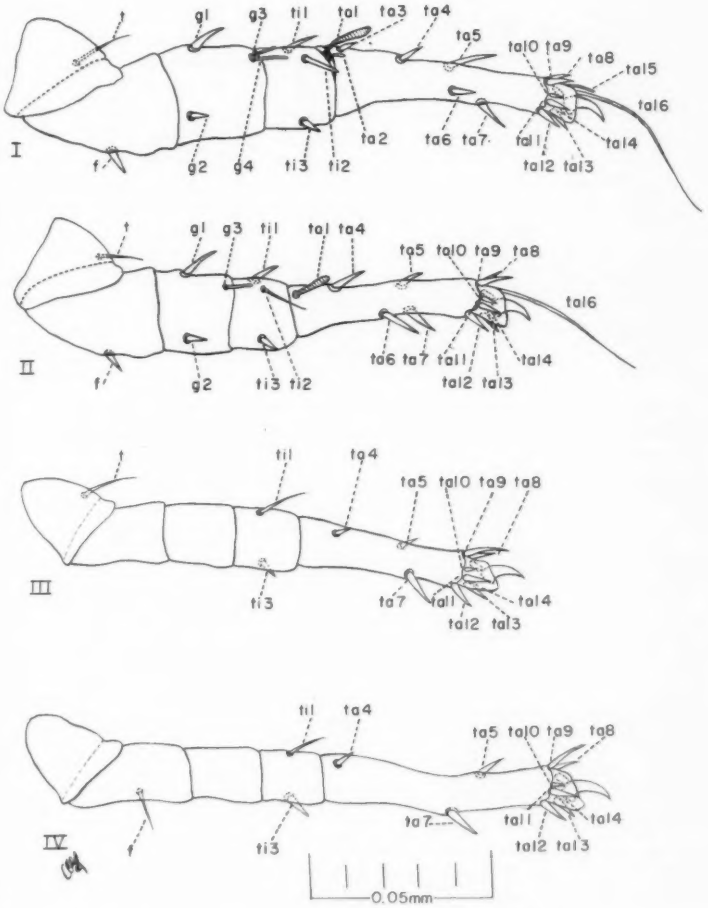

Plate 3 — *Histiostoma julorum* female. Dorsal view of legs.

the female but somewhat smaller. These lie close together between coxae IV and above external genitalia. What is assumed to be setae *vm1* have come to lie anteriad and slightly laterad of the anterior ring-like structure *r1*. Setae *vm2* and *vm3* have positions similar to those of the corresponding setae in the females. *Opisthosoma.* – The opisthosoma is much reduced in size as compared with the female. Ventrally the number and arrangement of setae are the same as for the female, except as follows: seta *vo1* is three times as long; seta *vo2* is about the same length but more mesially and posteriorly placed; seta *vo3* is marginal in position. A single pair of pit-like structures *vpi1* is found in the same relative position as in the female. The position of apodeme *a8* and the position of the anus are similar to that of the female. Bordering the anterior margin of the anus is the conspicuous, highly sclerotized genital apparatus. (Plate 4.) The male genitalia and associated structures are complex and difficult to interpret. The penial seta is a short chitinized hinged process normally directed posteriorly. The base or anterior end appears to be supported by two lateral winged chitinous structures. A pair of small lateral chitinous bars, each having a minute spicule, lie on either side of the penial seta. These do not appear to be true setae but rather chitinous extensions of the bars. A pair of posteriorly directed processes can be seen to lie on either side of the anus. At the anterior end of the anal slit a pair of spicules can be seen which have the appearance of being true setae.

Dorsum: *Propodosoma.* – Dorsally the relative size and arrangement of the setae are the same in both male and female. *Metapodosoma.* – The metapodosomal pit-like structures *dpi1*, and setae *dm1* – *dm5* are similar in size and arrangement to corresponding pit-like structures and setae in the female. *Opisthosoma.* – The type, size, and arrangement of the setae, the position of the excretory pores, and the number and position of the pit-like structures are very similar to those of the female. However, the male has one less pair of setae than the female. It is assumed that this is seta *do7* on the insecure grounds of relative position. It is possible that the minute spicules on the posterior margin of the genital plate, which were referred to above, are true setae. In this case ventral setae *vo1*, *vo2*, and *vo3* would become *vo2*, *vo3*, and *do7* respectively, and the spicules would become *vo1*. Thus, the number of body setae in the male and female would correspond and presumably be homologous. The position taken for the time being is that the spicules are not true setae and cannot be homologized with seta *vo1* in the female, and consequently the male has one pair less of opisthosomatic setae.

Legs: (Plates 4,5). *Leg I.* – Leg I of the male gives the appearance of being somewhat more massive than leg I in the female. Upon closer examination the difference in size is due primarily to the thicker and shorter male tarsus. The number of setae is the same in the male and female. The relative sizes and arrangement of the setae of the male

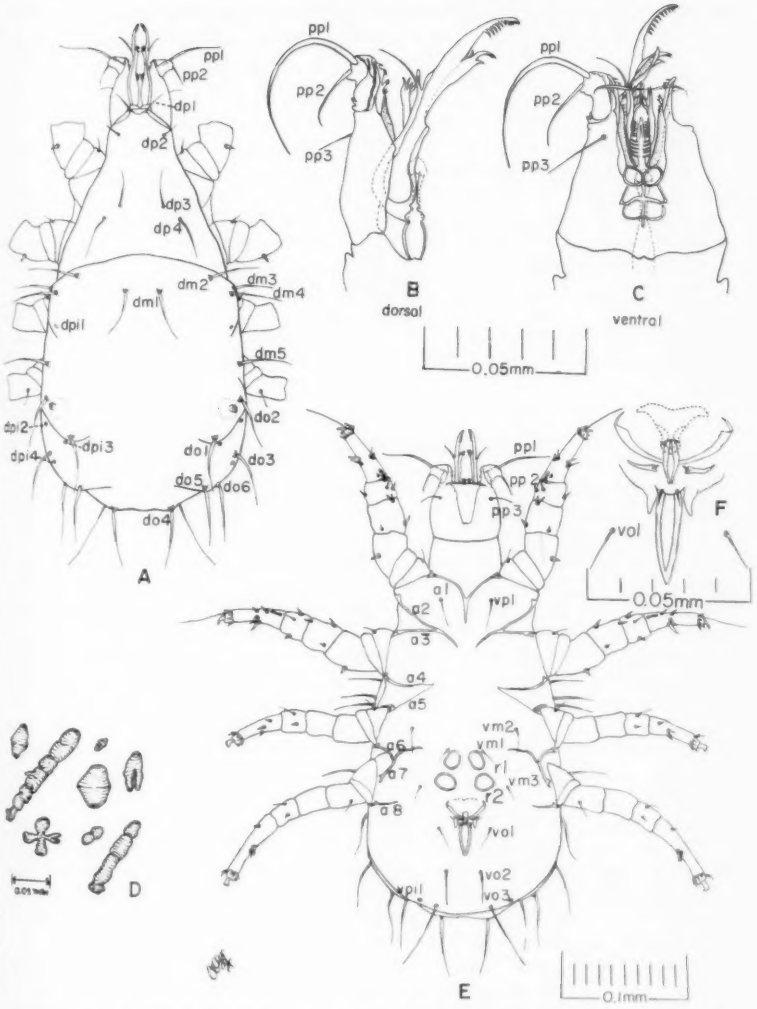

Plate 4 — *Histiostoma julorum*. A — male, dorsal view. B and C — details of gnathosoma. D — typical body crystals. E — male, ventral view. F — details of external genitalia.

are so similar to that of the female that the description of the setae for the latter generally apply, except as follows: setae *ta4-ta7* are less separated; *ta6* is longer and thinner; *ta7* is twice as massive; *ta15* is a massive claw-like structure instead of thin blunt seta. The claw is somewhat heavier than that of the female leg I. *Leg II.* – Male leg II is very similar to that of the female. The tarsus is slightly shorter than in the female and the mid-tarsal setae and claw give the appearance of being somewhat heavier. *Leg III.* – There are only very minor differences between leg III of the male and the female except for the very unusual serrated claw of the former. Tarsus III of the male is somewhat shorter than tarsus III of the female. *Leg IV.* – The only conspicuous difference between leg IV of the male and female is that the claw of the male is serrated as in leg III. The male tarsus is again slightly shorter than in the female. *Claws.* – Claws legs I-II are similar to those of the female. The peculiar serrated claws of the male legs III-IV are unique among the anoetids so far studied.

DESCRIPTION OF LARVA

General features. – (Plate 6). Average length 0.175 mm.; average width 0.115 mm. With the exception of a few conspicuous features the larva is in effect a miniture adult female. Gnathosomal structures are the same as in the female. As is typical of other acarids only the first three pairs of legs are found in the larva. The number, arrangement, and relative size of the leg setae of the larva virtually duplicate the condition found in the corresponding legs of the female. The exception to this statement is that trochanter setae *t*, of female legs I-II, and III have not made their appearance. The opisthosoma is relatively smaller than in the female. The dorsum of the larva differs from the dorsum of the adult female. The dorsum of the larva differs from the dorsum of the adult feseparate boss with adjoining setal bosses sometimes fusing to form a single large prominence. Also there are two large elevated surfaces, one anteriad of the conspicuous dorsal sulcus, and the other posteriad of this sulcus. It may be noted that there are no primary or secondary sex structures. Also there are no pit-like structures, and no excretory pores in the larva. Opisthosomatic setae *do4*, *do6*, and *do7* of the adult female, as judged by relative positions of such setae in the adult, dò not make their appearance in the larva. No granulation or sculpturing of the rostrum is seen. The venter of the larva differs from the venter of the female, as follows: there is an absence of sex structures; no pit-like structures can be seen; only the extremely tiny body setae *vp1*, *vm2*, and *vo3*, which would seem to correspond to like named setae of the female, can be seen. It is interesting that setae *vm1*, *vm3*, *vo1*, and *vo2* are missing. There is only one pair of ringlike structures, and these are found in a lateral posi-

tion posteriad of the first pair of legs instead of posteriad of the second pair of legs in the adult female or on the metapodosoma as in the male. The ringlike structures of the larva are morphologically similar to ringlike structures of nymphs and adults except they lie on slight prominences.

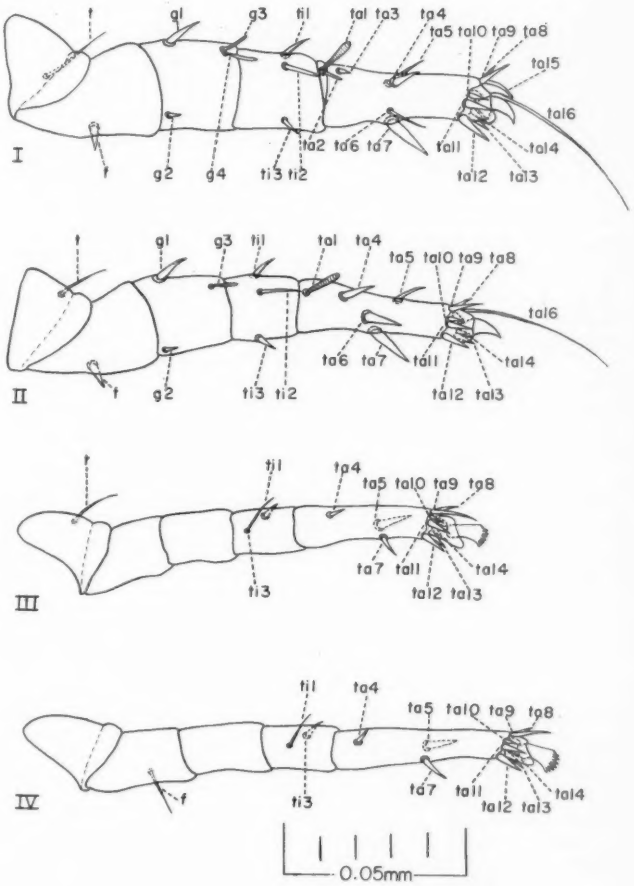

Plate 5 – *Histiostoma julorum* male. Dorsal view of legs.

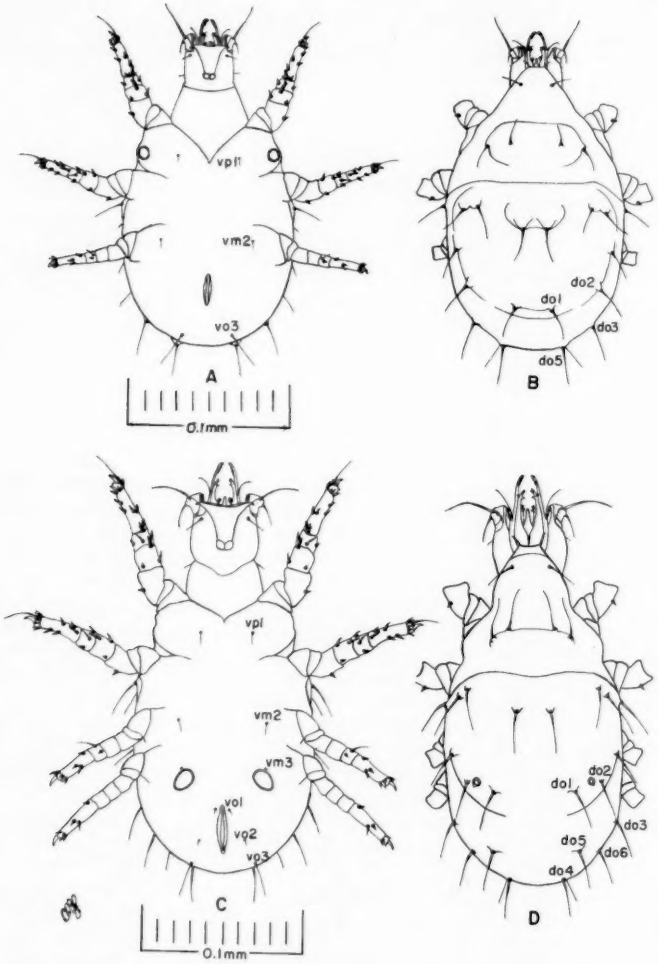

Plate 6 — *Histiostoma julorum*. A — larva, ventral view. B — larva, dorsal view. C — protonymph, ventral view. D — protonymph, dorsal view.

DESCRIPTION OF PROTONYMPH

General features. — (Plate 6). Average length 0.215 mm.; average width 0.110 mm. The larva metamorphoses into a protonymph stage with the fourth pair of legs being added. The protonymph is even more like the adult female than the larva. The gnathosoma is essentially a duplicate of the adult except for size. The setal pattern of each of the first three legs is the same as in the adult female, except as in the larva the trochanter setae *t* have not made their appearance. It is interesting that the number of setae of the fourth pair of legs is much reduced as compared with the adult. The missing setae are as follows: the femoral, the two tibial, and three of the seven terminal tarsal setae associated with the claw. The bosses and elevations noted in the larva are still present in the protonymph but are somewhat less conspicuous. The excretory pores make their appearance in the protonymph and are found in the same position as in the adult. No sculpturing, or granulation can be seen on the rostrum. Neither primary nor secondary sexual structures have made their appearance. The number, size, arrangement, and relative position of the setae of the dorsum duplicates the condition found in the adult female, except for the marginal seta *do7* which is missing. Hence, the protonymph is male-like in dorsal setal pattern. The venter of the protonymph has essentially the same pattern of setae as the adult female. However, seta *vm1* has not made its appearance, and all the setae are so small that they can be seen only after the most careful searching. This applies especially to seta *vm3* which is exceedingly minute. It will be noted that the protonymph has acquired three additional pairs of ventral setae as compared with the larva, namely: *vm3*, *vo1*, and *vo2*. Again, as in the larva, there is one pair of ringlike structures but a shift in position of these structures has taken place. These are now located on a line between coxae IV. It may be remarked at this point that the protonymph has alternative pathways to ensuing stages. It may metamorphose into the deutonymph, or migrant stage; or it may metamorphose directly into the tritnoymph stage. Attention should be given also to the fact that the claws on legs III-IV are similar to that of the female rather than the male. Pit-like structures have not been seen in the protonymph.

DESCRIPTION OF THE DEUTONYMPH

General features. — (Plates 7,8). Average length 0.193 mm.; average width 0.142 mm. The deutonymph is distinctly specialized and different from any other stage in the life cycle of an anoetid. The color is pinkish-brown instead of whitish as in the trophic form. It has heavier sclera and is shield-shaped. It is an active form which may explore all parts of its habitat, or it may lie in wait for a moving object, *e.g.*, a larger mite or an insect, to which it will firmly attach itself by a pair of

well developed suckers.

Gnathosoma. — The gnathosoma is vestigial as compared with the adult, or other stages. It is represented by what appears to be a pair of almost completely fused pedipalps, and the gnathosomal base is obscured from view dorsally by the overhanging rostral portion of the propodosoma. The fused pedipalps bear a pair of long flagella-like setae *pp1*, equal to length of tarsus II, and a pair of minute setae *pp2*. The mouth and associated structures are absent. At the base of the pedipalps a heavily sclerotized ring or collar can be seen.

Venter: *Propodosoma.* — The anterior limits of the propodosoma are marked by the heavily sclerotized apodemata *a1*. The posterior limits of the propodosoma are apodemata *a4*, and a continuation of this structure anterio-laterad to the margin of the dorsal sulcus. Apodemata *a1* join posteriorly in the midline to form the anterior portion of the sternum *st1* which ends free. Anteriorly apodeme *a1* ends in a T-shaped chitinous bar which makes contact with the gnathosomal collar. Apodeme *a2* is also heavily chitinized and ends in a bifurcated process anteriorly and laterally. Posteriorly *a2* almost makes contact with the medial portion of apodeme *a4*. A ringlike structure *di1* lies near the anterior end of apodeme *a2* on coxa I. Apodeme *a3* is made up of a posterior portion, almost membranous-like; and an anterior process which is heavily sclerotized and lies at the lateral margin of trochanter II. The membranous portion is continuous posteriorly with apodeme *a4*. Apodeme *a4* from the point of contact with *a3* projects mesially as a heavy bar and almost makes contact with *a2*. Associated with this portion of *a4* can also be seen a faint membrane lying beneath the surface of the venter. This joins with the similar membrane from the other side to form a very faint line which almost makes contact with the middle sternum *st2*. Laterally and posteriorly *a4* ends in a heavily sclerotized process lying at the base of trochanter III. Laterad of the chitinous process of apodeme *a3* a fine seta *dm4* is seen. This ventral seta appears to correspond to the dorsally placed seta *dm4* of the female. *Metapodosoma.* — Apodeme *a5* lies at the anterior end of trochanter IV and continues mesially to join the middle sterna *st2* and *st3*. Laterally *a5* is continuous with apodeme *a6*. A ringlike structure *di2* lies on coxa III above *a5* and is equidistant from trochanter III and *st2*. Apodeme *a6* is continuous with *a5* at the anterior end of trochanter IV and proceeds posteriorly and mesially to join a Y-shaped portion of the sternum *st4*. A faint transverse line, not strong enough to be an apodeme, connects the lateral junctures of *a5* and *a6*. A conspicuous ellipsoidal ring is seen just below *st4*. Within this structure is a longitudinal depression with two very faint rings on each side. This has been called the genital opening by a number of workers. Since external genitalia do not make their appearance until the adult stage, it is doubtful that this depression represents even a vestigial genital structure. The function of

the oval structure is not known. A pair of very minute setae *vm1* are seen between the oval structure and the coxal IV discs *di3*. Posteriorly the metapodosoma is bounded by a transverse line coinciding with the anterior margin of the suctorial plate. *Opisthosoma.* — What is designated the ventral opisthosoma in the deutonymph is almost entirely made up of a large, conspicuous suctorial plate. The lateral and posterior margins of this plate are marked by very faint radial striations. Four pairs of distinct disc-like structures are found within the plate. The most anterior pair *su* are functional suckers for attachment to insects and other organisms. They can be seen in living animals under favorable conditions extended for a distance approximately two or three times their diameter. This is the only pair of functional suckers in the suctorial plate. The pair of plate discs *pd1*, just posteriad of the suckers are larger in diameter than the other discs, or the suckers. Radial striations define their borders. Laterad and posteriad of disc *pd1* are found two other pairs of distinct raised discs *pd2* and *pd3*. These discs are similar in general appearance to coxal discs *di1* and *di2*, although somewhat larger. Very faint, indefinite bodies (*b1* and *b2*) can be seen in each quadrant of the suctorial plate in marginal positions. These bodies may represent degenerate suckers, but there is no evidence for this. In the mid-line between the suckers *su* a small but fairly distinct structure *an* can be seen which is reminiscent of an anus. It is not certain that *an* is an opening, and it is chiefly because of its position that it is suggestive of an anus. It has been observed to pulsate when the suckers are distended, which may indicate that it has a hydrostatic function. In the mid-line lying between discs *pd3* and posteriad of *an* a very faint, indefinite, oblong body *b3* may be seen. At the posterior margin of the suctorial plate, seta *vo3* may be seen.

Dorsum: *Propodosoma.* — The anterior portion of the propodosoma forms a slight rostrum which partially overhangs the fused pedipalps. A definite sulcus marks the posterior limit of the propodosoma, which is smooth except for faint transverse sculpturing. Two pairs of short, fine setae *dp3* and *dp4* are seen slightly anteriad of the sulcus. What appears to correspond to setae *dp1* and *dp2* of the adult and other stages, including the larva, are missing. *Metapodosoma.* — The cuticle immediately posterior to the sulcus is faintly striated transversely. The setae of the metapodosoma are fine and of equal size. They are the same length as those of the opisthosoma and slightly longer than those of the propodosoma. The pattern of the setae is somewhat similar to that of an adult. For convenience in identifying these setae, but without necessarily implying homology, they have been given numbers which correspond to setae similarly located in the female. If this scheme is followed it will be noted that seta *dm4* is in a ventral position as indicated above. A line connecting setae *dm5* marks the posterior limits of the metapodo-

soma dorsally. This boundary insures approximate correspondence of setae of the deutonymph with the setae of other stages. *Opisthosoma.* – Neither excretory pores nor pit-like structures can be detected on the dorsal surface of the opisthosoma. Again the setae have been arbitrarily labeled to more or less conform to similarly placed setae of other stages. All of the setae are equal in length. It will be noted that the number of opisthosomatic setae of the deutonymph dorsum is the same as for the protonymph, tritonymph, and male; two more than in the larva, namely *do4* and *do6;* and one less than the female *do7*.

Legs (Plates 7, 8). – All of the legs of the deutonymph are long, tapering and heavily sclerotized. *Leg I: Coxa.* – The coxa of leg I bears no setae in contrast with the adult female which bears one coxal seta *vp1*. *Trochanter.* – The trochanter has no definite setae, but in the same position of the trochanter seta *t* of the adult is seen what appears to be a minute spine-like process of the cuticle *t2*. On the dorsal surface there is a similar process *t1*. It will be recalled that neither these processes nor true setae can be found on the trochanter of the larva or the protonymph. *Femur.* – The femur bears one seta *f* obviously corresponding to a similar seta of the adult and all other stages. *Genu.* – The genu bears three conspicuous setae *g1*, *g2*, and *g3*. It is assumed that a seta corresponding to *g4* of the adult and all other stages is missing. *Tibia.* – The tibia bears only two setae which are assumed to be *ti1* and *ti3* in contrast with the adult and all other stages which have three setae. *Tarsus.* – A cluster of the most conspicuous setae of the tarsus *ta1*, *ta2*, and *ta3* seem to arise from the distal portion of the tibia but actually take their origin from the proximal portion of the tarsus. The club-shaped, striated sensory seta *ta1* is obviously homologous with the corresponding structure of other forms. The homology or even correspondence of other setae of the tarsus is indeed most uncertain. Using as the criterion the relative position of setae, the same numbers have been used to designate apparent counterparts in the adult. On this basis setae *ta9*, *ta10*, *ta11*, *ta13*, and *ta14* are missing as compared with other stages. Attention is invited to the lancet-like seta *ta15;* to the distinctive spoon-shaped sensory seta *ta16;* the extremely long tapering seta *ta3* which is longer than tibia I. The morphology of these setae is peculiar to the deutonymph. *Leg II: Coxa.* – As in the adult and other stages no coxal setae are present in the deutonymph. *Trochanter.* – The trochanter bears two spine-like processes *t1* and *t2* similar to those found in trochanter I. *Femur.* – The femur bears one seta *f* comparable in size and position to a similar seta on femur I. *Genu.* – The number and arrangement of setae on genu II is very similar to that of genu I. The atypical seta g3 is almost twice as long as the corresponding seta of genu I. *Tibia.* – It appears that tibia II has an additional seta as compared with tibia I, namely *ti2*. In addition there is no cluster of tarsal setae *ta1-ta3* apparently inserted in the tibia.

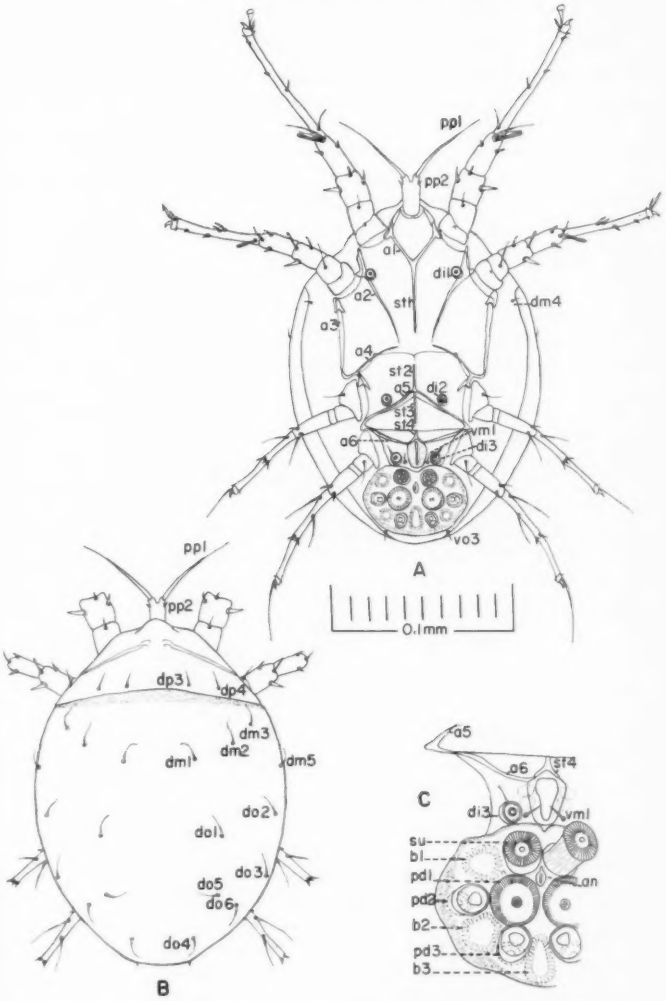

Plate 7 — *Histiostoma julorum* deutonymph. A — ventral view. B — dorsal view. C — details of suctorial plate.

Tarsus. – The tarsus is considerably modified as compared with tarsus I. The striated seta *ta1* is present but the atypical setae *ta2* and *ta3* associated with it in tarsus I are missing. What is assumed to be seta *ta4* has moved distally to become closely associated with seta *ta5*. Seta *ta16* is lancet-like instead of spoon-shaped as *ta16* of tarsus I. In other details tarsus II is similar to tarsus I. *Leg. III: Coxa.* – No setae can be seen on coxa III. *Trochanter.* – The trochanter bears one long seta *t* comparable in type and position to the trochanter seta of the adult. *Femur.* – As in other stages the femur of leg III bears no setae. *Genu.* – What is assumed to represent the genu of leg III is reduced to approximately one-fourth the length of genu I or II, and is devoid of setae. *Tibia.* – Two setae are present as in tibia III of the adult. These are found at the distal end, one *ti1* which is spine-like and the other *ti3* much longer and finer. The separation of the tibia from the tarsus is by a very indistinct line just distal to setae *ti1* and *ti3*. *Tarsus.* – This is peculiar in that it appears to be segmented. A cluster of three small setae *ta5*, *ta6*, and *ta7* is found at the distal end of the first incipient segment. A long hairlike seta *ta4*, assumed to correspond to seta *ta4* in the adult is seen in the proximal portion of this first segment. A striking difference between tarsus II and III is that in the latter seta *ta15* is missing. Also *ta16* is long and tapering instead of lancet-shaped as in tarsus II. *Leg IV: Coxa.* – The coxa of leg IV bears one seta *vm1*. *Trochanter.* – This is similar in shape and size to trochanter III, but bears no setae. *Femur.* – The femur bears one seta *f* similar in shape and size to seta *t* of trochanter III. *Genu.* – This is in all respects similar to genu III. *Tibia.* – This bears two setae *ti1* and *ti3* corresponding to similar setae on tibia III. Seta *ti3* of tibia III is about twice as long as *ti3* of tibia IV. *Tarsus.* – The tarsus also appears to be segmented, but this is by no means certain. The number of setae is the same as for tarsus III but there are distinct differences in size and arrangement. What are arbitrarily assumed to correspond to setae *ta4* and *ta7* of tarsus III are much longer, and *ta7* has shifted to a more proximal position. Seta *ta16* is about twice as long as the corresponding seta of tarsus III.

DESCRIPTION OF TRITONYMPH

General features (Plate 9). – Average length 0.218 mm.; average width 0.125 mm. In general the tritonymph is very similar in appearance to a non-gravid female. The type, arrangement, and relative size of the setae are precisely the same as for the female, including trochanteral setae of legs I-III, and the femoral, tibial, and tarsal setae of the leg IV, which latter are missing in the protonymph. The setal pattern for the remainder of the body is the same as for the female, except one pair of opisthosomatic setae, assumed to correspond to *do7* of the female is not present. It

will be recalled that this is the condition existing in the protonymph, and therefore, with respect to the dorsal setae pattern these two stages are similar to the male. Again no sculpturing or granulation can be seen on the rostrum. The bosses and elevations noted in the protonymph and larva can also be seen in the tritonymph but are not quite so prominent.

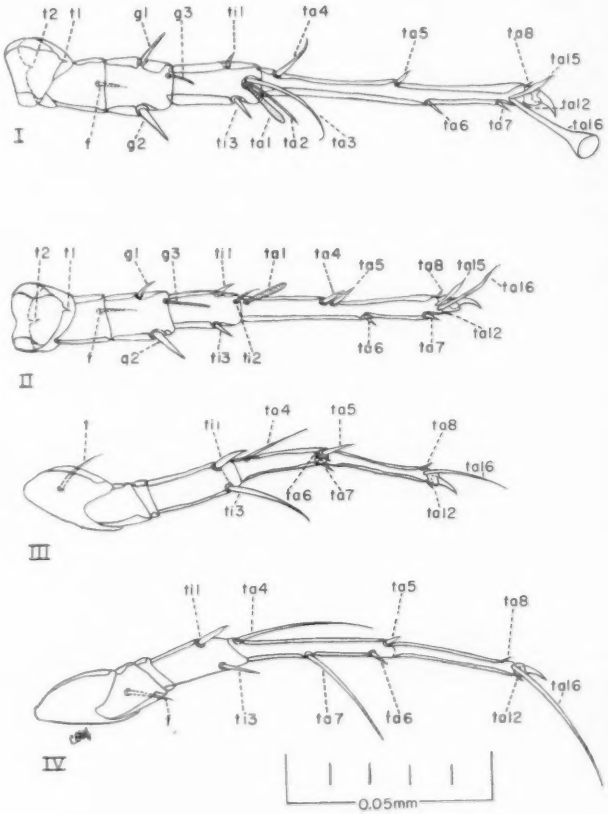

Plate 8 – *Histiostoma julorum* deutonymph. Dorsal view of legs.

It will be noted that metapodosomal seta *vm1* has now made its appearance. Two pairs of ring-like structures can be seen in the tritonymph, but their position is different from the position of similar structures in the male or the female. These ringlike structures tend to lie between coxae IV. It will be noted also that the claws of legs III and IV are female-like as in the protonymph. Of special interest is the lack of excretory pores. It is not understood why these structures, which make their appearance in the protonymph, disappear in the tritonymph and reappear in the adult. Pit-like structures cannot be seen in the tritonymph. Neither primary nor secondary sex structures have made their appearance at this stage.

Variations in H. julorum. — Two interesting and distinctly different "varieties" of this species have been collected, one of them three times in different localities. We are tentatively taking the position that these "varieties" are not sufficiently distinct to be classified as true taxonomic varieties or sub-species of the "type variety" described above. Planned cross-breeding experiments should throw light on this question. Both of these "varieties" breed true and differ from each other and the "type variety" in a number of features, the more useful of which for identification purposes in the male are as follows: (Plates 9, 10, 12). "type variety" — claws III-IV serrated; no outstanding hysterosomal elevations or enlarged setae bases; "bursoid variety" — distinct dorsal median elevation on the hysterosoma resembling a bursa copulatrix; claws III-IV not serrated; "2-boss variety" — setae *do1* closer together mounted on slight but distinct elevations; claws III-IV not serrated.

Comparison of females (Plates 11, 12). — Only very minor differences among the females of the three "varieties" have been noted. Tarsus I of "bursoid" is slightly heavier than "type" and "2-boss" and the mid-tarsal setae are closely grouped. Tarsus II is essentially the same for each "variety." Tarsus III seta *ta9* of "2-boss" longer, and seta *ta7* of "bursoid" longer and heavier than other "varieties." Seta *ta9* tarsus IV of "2-boss" slightly longer than other "varieties." The structure of the bursa copulatrix for each "variety" is different. If our interpretation of these minute organs is correct the morphology of the bursa copulatrix of each "variety" most closely matches the male genitalia of its own "variety." For example, the penial seta of the "type" is directed posteriorly and thus matches the posteriorly directed bursa copulatrix orifice. Other small differences in the morphology of the bursa copulatrix and the corresponding differences in the male genitalia suggest an incipient or actual sexual isolation mechanism in these "varieties."

Comparison of males (Plates 9, 10, 12). — In addition to the differences in the males of the three "varieties" referred to above, the males also differ in a number of other characters. The ringlike structures, al-

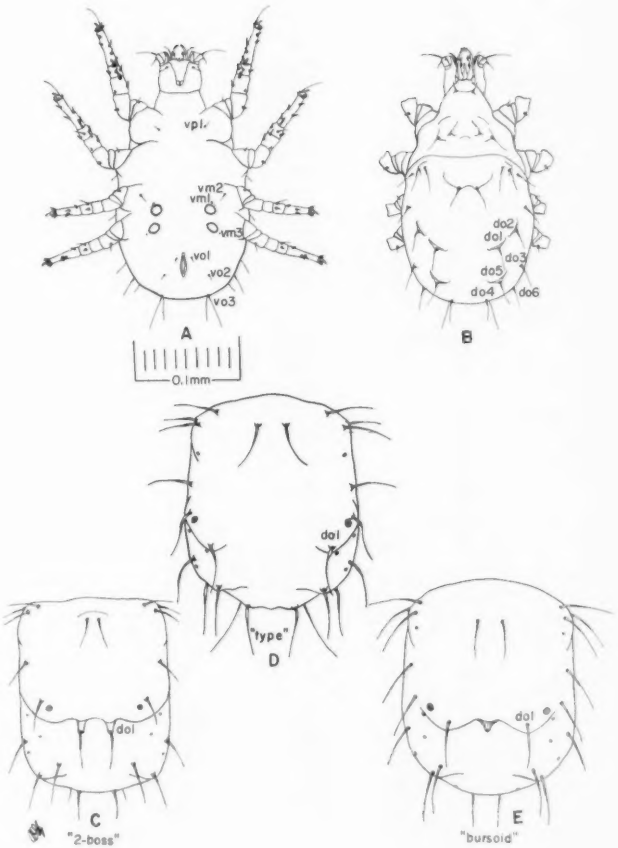

Plate 9 — *Histiostoma julorum*. A — tritonymph, ventral view. B — tritonymph, dorsal view. C, D, E — males, dorsal hysterosoma of the three "varieties" — "type," "bursoid," and "2-boss."

though somewhat variable in size, shape, and position even among individuals of the same "variety" are typically as shown in Plate 12. Seta *vm3* is posteriad and laterad of *r2* in "type," but is more anterior in position in "2-boss" and "bursoid." Seta *vo1* in "2-boss" is very close to the

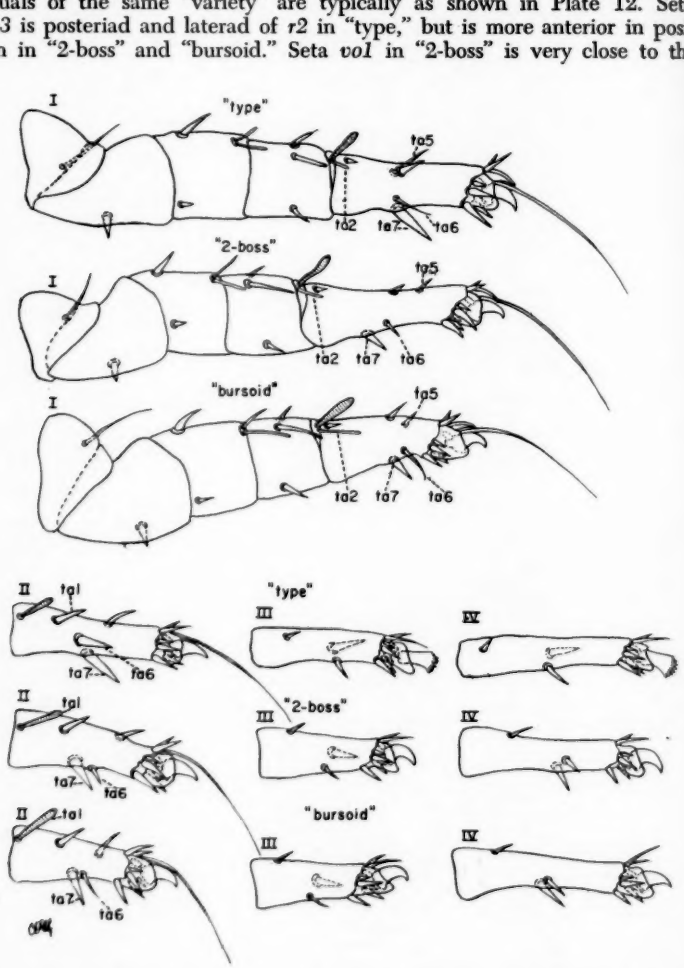

Plate 10 – *Histiostoma julorum* males. Dorsal view of legs I, and tarsi II-IV of the three "varieties" – "type," "2-boss," and "bursoid."

posterior margin of the external genitalia in comparison with the other two "varieties." Seta *vo2* is laterad of the posterior end of the anus in "type" and "2-boss" and laterad of the anus in "bursoid." The "variety bursoid" has a distinct genital plate with *vo3* located on its posterior margin. "Varieties 2-boss" and "type" are without a genital plate, and *vo3* is located more posteriorly. The legs of the three "varieties" differ in a number of definite features. Mid-tarsal setae leg I of "type" are more closely grouped, *ta5* longer, *ta7* stouter than "2-boss" and "bursoid." "Bursoid" has a short tarsus I with *ta2* nearly equal to *ta1*; *ta6* of "2-boss" shorter than *ta6* of "bursoid" and "type." Leg II tarsus seta *ta6* of

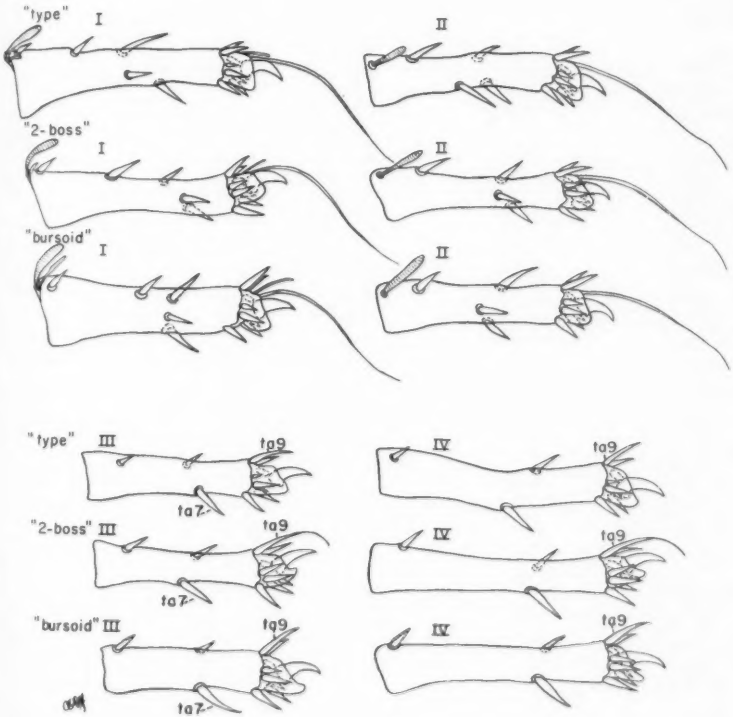

Plate 11 — *Histiostoma julorum* females. Dorsal view of the tarsi I-IV of the three "varieties" — "type," "2-boss," and "bursoid."

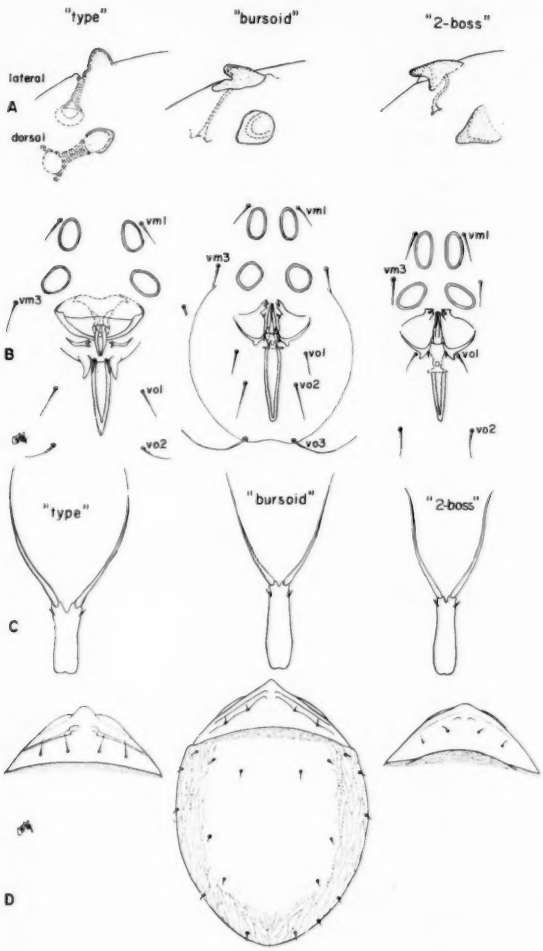

Plate 12 — *Histiostoma julorum* "varieties" — "type," "bursoid," and "2-boss." A — bursa copulatrix. B — external male genitalia. C — deutonymph, fused pedipalps and setae. D — deutonymph, propodosoma or dorsum.

"type" nearly equal to *ta7;* "2-boss" *ta6* smaller than *ta7;* "bursoid" *ta6* nearly equal but finer than *ta7;* seta *ta1* leg II smallest in "type," largest in "bursoid." Legs III-IV are very similar in all three "varieties" except for the serrated claws of "type."

Comparison of deutonymphs. — (Plate 12). The deutonymphs of all "varieties" are very similar. The fused pedipalps of "type" are broader and shorter, and the propodosomal setae distinctly longer in "type" than in "bursoid" or "2-boss." The margins of the hysterosoma are faintly sculptured in "bursoid," and there are minor differences in transverse sculpturing and striations.

BIOLOGY

Habitat. — Although *H. julorum* has been collected by the methods described above in a variety of situations, trophic forms have been seen only in niches which contain moist decaying organic matter. Collections made in lawns, pine woods, and other relatively dry areas can be accounted for by the trapping of insects and other arthropods which are infested with deutonymphs. In a suitable culture medium, or when they find themselves in a suitable natural habitat, the deutonymphs will metamorphose into the trophic forms, and in this manner establish a new colony.

Culture. — As judged from the variety of niches in which this species has been collected, and through observations made in the laboratory, it appears that almost any type of decaying organic matter will serve as a culture medium. Both the house fly and fruit fly media described above support thriving colonies. It is essential that the medium be moist since, as for most anoetids, they prefer to wade in a thin film of water. This probably facilitates movement and hence makes an abundant food supply accessible. They appear to be continuous and non-specific feeders when observed under a microscope. Although no extended experiments have been undertaken to determine nutrient requirements or preferences for members of this species, it appears that yeasts and other microorganisms form their main diet. Culture technique for this species is the same as for most other anoetids and is described above.

Life cycle. — Under optimum conditions of culture at room temperature, only six days is necessary for completion of the life cycle of *H. julorum.* This period apparently can be lengthened indefinietly under crowded conditions. The sequence of stages is as follows: egg — larva — protonymph — tritonymph — adult, or egg — larva — protonymph—deutonymph — tritonymph — adult. Each of these stages is distinct morphologically, and is described above in detail. The surprising observation that a protonymph may take alternative pathways to reach the adult stage *i. e.,* it may omit the deutonymph — is commented on below. This was determin-

ed by observing protonymphs in the quiescent state. In some of these fully formed tritonymphs could be seen. In others fully formed deutonymphs could be observed. The period of time required for each developmental stage has not been determined accurately. They appear to be roughly equal when the entire cycle is completed in six days. It has been noted, however, that eggs vary greatly in their degree of development at the time of oviposition, from the blastula stage at one extreme to a fully formed larval stage at the other. Except for the deutonymph, it appears that each stage progresses to the next without interruption, when the food supply is adequate, with a quiescent period in between each stage. In the case of the deutonymphs it has been observed that some deutonymphs will metamorphose into tritonymphs in a matter of hours, while others under apparently the same conditions will remain in the deutonymph stage for as long as several weeks. The ability of the deutonymph to delay or vary the time of onset of metamorphosis, like its many other adaptive features, is befitting to its role as a dispersal stage of the species, but nothing is known at present about what conditions or mechanisms trigger metamorphosis.

Every developmental stage, including the adult, shows very considerable size variation. This is true even when the specimens measured come from inbred strains and are cultured under the same conditions. Plate 13 gives the results of a series of measurements on individuals selected at random from inbred stock cultures. All measurements were made on specimens mounted in Hoyer's medium. It will be noted that individuals of some stages may be as much as twice the length of other individuals of the same stage and, moreover, that there is much overlap between different stages. The variation in length is assumed to be due primarily to small chance differences in consumed nutrients because of localized crowding partial dessication of the culture medium, and other conditions. It is obvious from the above that caution must be exercised in using size as a criterion for determination of species.

H. julorum exhibits male parthenogenesis. Careful observations have shown that isolated virgin females produce only male offspring. Fertilized eggs give rise to females.

That ringlike structures in the anoetids may actually be vestigial suckers, is strengthened by the following observations. The larvae of both the Acaridae and Anoetidae typically have a single pair of ringlike structures or suckers located posterior to the first pair of legs; in the protonymphs of both families a single pair of ringlike structures are present but now displaced to the opisthosoma; likewise a parallelism of these structures exists in the tritonymph where two pairs of suckers or ringlike structures are found. Further correspondence in position of these structures occurs in the adult. However, it must be noted that in no described

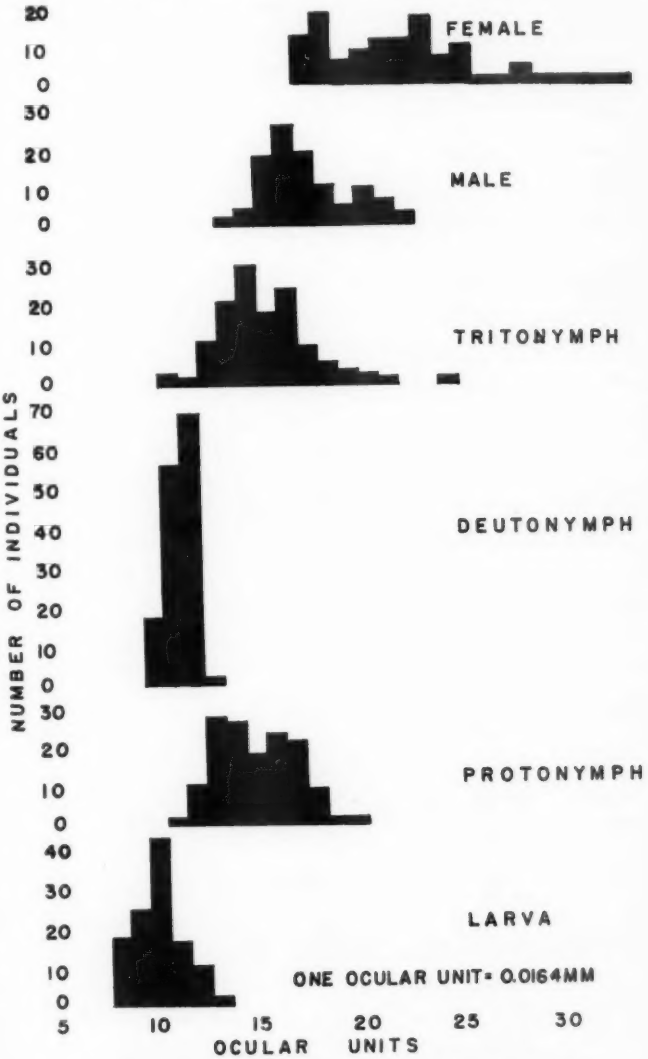

Plate 13 — *Histiostoma julorum* — size range of various stages.

species of the Anoetidae is there any evidence that these ringlike structures function as suckers.

Collections. – Random and sporadic collecting trips have yielded the following results:

"type variety"

DATE	LOCATION	COLLECTOR
Sept. 1950	Wooded area 9 miles west of Richmond, Va.	R. D. Hughes
Oct. 1950	Wooded area near Bluefield, W. Va.	G. S. Foresman
Oct. 1950	Compost 10 miles north of Richmond, Va.	R. D. Hughes
Oct. 1950	Wooded area 8 miles west of Richmond, Va.	C. O. Goode
Nov. 1950	Wooded area 9 miles west of Richmond, Va.	R. D. Hughes
Aug. 1951	Pine woods near Norris Dam, Tenn.	R. D. Hughes
Oct. 1951	Pear orchard 8 miles east of Richmond, Va.	R. D. Hughes
Oct. 1951	Chickahominy Swamp near Ellerson, Va.	R. D. Hughes
Dec. 1951	In orange grove, Lantana, Fla.	Mr. Blood
May 1952	Near Appomattox River, Colonial Heights, Va.	J. B. Williams
June 1952	Damp woods near Victoria, Va.	A. E. Glover
June 1952	Wooded area near Vernon Hill, Va.	F. C. McDowell
June 1952	Wooded area near Hackettstown, N. J.	R. L. Shevitz
June 1952	Compost heap near Valley Stream, N. Y.	C. E. Bingley, Jr.
June 1952	Swamp near Woodlawn, Va.	R. D. Jones
June 1952	Old apple orchard near Covington, Va.	E. F. Kohne
Oct. 1952	Shady lawn in Ellerson, Va.	R. D. Hughes

DATE	LOCATION	COLLECTOR
Aug. 1953	Chickahominy Swamp near Efflerson, Va.	R. D. Hughes
June 1954	Cone River area near Warsaw, Va.	A. H. O'Bier
Sept. 1955	Pine woods near Mechanicsville, Va.	F. A. Robertson
Sept. 1955	Under grapevine near Efflerson, Va.	R. D. Hughes
	"2-boss variety"	
June, 1954	Near Warsaw, Va.	A. H. O'Bier
Oct. 1954	North of River Road 9 miles west of Richmond, Va.	F. A. Robertson
	"bursoid variety"	
June 1954	Near Warsaw, Va.	A. H. O'Bier

In addition to the above recent collections from eastern United States it has been reported also from Europe, as follows:

1841 Germany; on *Julus unilineatus* (*Hypopus julorum* Koch) C. L. Koch

1844 On *Julus* (*Hypopus ovalis* Gervais) Gervais

1849 On insects (*Hypopus vulpis* Dujardin) Dujardin

1886 Italy; in organic matter, deutonymph on *Julus mediterraneus* (*Hypopus julorum* Koch) A. Berlese

1888 Venice; in organic matter on *Julus mediterraneus* (*Histiostoma julorum* Koch) C. Canestrini

1905 Sumatra; on *Sphaeridium dimidiatum* Cast. (*Histiostoma sumatrensis* Oudemans) C. Fisher

Types. — Holotype no record. Plesiotypes (supplied by present authors) located as follows:

U. S. National Museum, Washington, D. C.

British Museum of Natural History, London, England

Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands

Museum National d'Histoire Naturelle, Paris, France

The South Australian Museum, Adelaide, South Australia

Natal Museum, Pietermaritzburg, Union of South Africa

National Collection, Ottawa, Canada
USSR Academy of Science, Moscow and Leningrad, USSR
Musee Royal d'Histoire Naturelle de Belgique, Brussels, Belgium

KEY TO THE SPECIES OF THE GENUS *Histiostoma* BASED ON FEMALES

1. A terminal tarsal seta, legs I-IV, flagella-like 2
   A treminal tarsal seta, legs I-II only flagella-like 6

2. Dorsal hysterosoma heavily shagreened and with distinct bosses ..... *H. protuberans*, sp. nov.
   Dorsal hysterosoma not shagreened and without distinct bosses 3

3. Anterior and posterior ringlike structure *r1* and *r2* circular, or almost circular 4
   Posterior ringlike structures oval or elongated 5

4. A terminal tarsal seta leg IV longer than tarsus IV .... *H. pyriforme*
   Longest terminal tarsal seta, leg IV, shorter than tarsus IV. *H. berghi*

5. Pedipalpal seta *pp1* spine-like and anteriorly directed; seta *vm3* posterior to posterior ringlike structure *r2* — *H. sextoni*, sp. nov.
   Pedipalpal seta *pp1* flagella-like and laterally directed; seta *vm3*, mesiad of posterior ringlike structure *r2* ..... *H. cyrtandrae*

6. Setae on dorsum pilose ..... *H. piloseta*, sp. nov.
   Setae on dorsum not pilose 7

7. Chelicera ending with minute seta with terminal knob; pedipalp with many bristle-like projections distally and laterally *H. bakeri*, sp. nov. Without knobbed seta, or without seta on end of chelicera; without bristle-like projections associated with the pedipalp 8

8. Posterior end of posterior disc *r2* on level with anterior end of anus ..... *H. himalayae*
   Posterior end of posterior disc *r2* distinctly anterior to anus 9

9. Posterior disc *r2* ovate, or elongate 10
   Posterior disc *r2* circular, or almost circular 13

10. Seta *vm3* laterad of and on a level with posterior disc *r2* *H. fimetarium*
    Seta *vm3* not laterad of posterior ventral disc *r2* 11

11. Tarsal seta *ta5* legs III-IV ending in distinct hook, or barb ..... *H. phyllophorus*

Tarsal seta *ta5* legs III-IV without hook or barb 12

12. Cheliceral flagella equal to or longer than serrated portion of chelicera; seta *vm3* mesiad of and opposite posterior disc *r2* ..... *H. humiditatis*
Cheliceral flagella shorter than serrated portion of chelicera; seta *vm3* posterior to or near end of posterior disc *r2* *H. nigrellii*, sp. nov.

13. Pedipalpal seta *pp2* apparently missing; posterior disc *r2* on a line between coxa II and III ..... *H. murchiei*, sp. nov.
Pedipalpal seta *pp2* present; posterior disc *r2* not on a line between coxa II and III 14

14. Pedipalpal seta *pp1* spine-like and nearly equal to seta *pp2* *H. feroniarum*
Pedipalpal seta *pp1* flagella-like and over twice as long as *pp2* 15

15. Chelicera not serrated; seta *vm3* below and laterad of posterior ventral disc *r2* ..... *H. gordius*
Chelicera serrated; seta *vm3* below and laterad of posterior ventral disc *r2* ..... *H. julorum*

KEY TO THE SPECIES OF THE GENUS *Histiostoma* BASED ON MALES

1. A terminal tarsal seta, legs I-IV, flagella-like; distinctly longer than claw 2
Only terminal tarsal seta on legs I-II flagella-like and distinctly longer than claw 6

2. A terminal tarsal seta legs I-IV nearly equal in length, as long or longer than tarsus ..... *H. pyriforme*
Longest terminal tarsal seta legs III-IV, shorter than tarsus IV. 3

3. Dorsal hysterosoma heavily shagreened, giving a sculptured effect 5
Dorsal hysterosoma not shagreened 4

4. Both anterior and posterior discs *r1* and *r2* lie close together and directly anterior to external genitalia ..... *H. berghi*
Posteriorly pair of discs *r2* widely separated and do not lie directly above external genitalia ..... *H. sextoni*, sp. nov.

5. Dorsal hysterosomal setae long, flagella-like, distinctly longer than tarsus IV ..... *H. phyllophorus*
Dorsal hysterosomal setae medium in length; shorter than tarsus IV ..... *H. protuberans*, sp. nov.

6. Both anterior and posterior pair of discs *r1* and *r2* lie close together and directly anterior to genitalia 7

   Posterior pair of discs *r2* widely separated and do not lie directly above genitalia 9

7. Dorsal hysterosomal setae as long or longer than genu I 8
   Dorsal hysterosomal setae minute; distinctly shorter than genu I *H. murchiei*, sp. nov.

8. Pedipalpal seta *pp1* over twice length of *pp2* ..... *H. fulorum*
   Pedipalpal seta *pp1* and *pp2* nearly equal ..... *H. feroniarum*

9. Both anterior and posterior pair of discs *r1* and *r2* distinctly elongated ..... *H. nigrellii*, sp. nov.
   Either or both anterior and posterior pair of discs *r1* and *r2* distinctly round 10

10. Pedipalpal seta *pp1* distinctly shorter than *pp2* ..... *H. himalayae*
    Pedipalpal seta *pp1* distinctly longer than *pp2* 11

11. Ventral seta *vm3* laterad of posterior disc ..... *H. fimetarium*
    Ventral seta *vm3* mesiad of posterior disc 12

12. Dorsal hysterosoma heavily shagreened, giving a sculptured effect ..... *H. gordius*
    Dorsal hysterosoma smooth ..... *H. piloseta*, sp. nov.

KEY TO THE SPECIES OF THE GENUS *Histiostoma* BASED ON DEUTONYMPHS

1. Dorsum partially or completely shagreened, pitted, or granular 2
   Dorsum smooth, or very faintly sculptured or striated, not granular 8

2. Dorsal setae minute, hairlike, and equal .... *H. protuberans*, sp. nov.
   Dorsal setae not minute, hairlike, or equal 3

3. Anterior margin of hysterosoma transversely striated dorsally 4
   Anterior margin of hysterosoma not transversely striated dorsally 7

4. Dorsal hysterosomal setae distinctly long and equal, except dorsal opisthosomatic setae *do4* and *do6* which are short and hairlike *H. gordius*
   Dorsal hysterosomal setae not as above 5

5. Two or three pairs of long, conspicuous, lancet-like setae

on hysterosoma 6
Hysterosoma without lancet-like setae; *dm1* as long as *pp1* *H. lorentzi*

6. Hysterosomal seta *dm1* short and peg-like ..... *H. tienhoveni*
Hysterosomal seta *dm1* long and lancet-like ..... *H. spinitarsus*

7. Only one pair of dorsal hysterosomal seta *do1* long and lancet-shaped ..... *H. ensifer*
Three or more pairs of dorsal hysterosomal setae long and saber-like 8

8. Only three pairs of dorsal hysterosomal setae long and saber-like ..... *H. lanceocrinus*
More than three pairs of dorsal hysterosomal setae long and saber-like ..... *H. gladiger*

9. Anterior margin of dorsal hysterosoma transversely striated 10
Anterior margin of dorsal hysterosoma not transversely striated 20

10. Majority of dorsal setae longer than tibia I 11
No dorsal setae as long as tibia I 13

11. Soma conspicuously pear-shaped; fused pedipalps projecting distinctly beyond propodosoma ..... *H. fimetarium*
Soma pear-shaped; fused pedipalps not projecting, or barely projecting beyond propodosoma 12

12. Sternum *st1* continuous with sternum *st2* ..... *H. phyllophorus*
Sternum *st1* not continuous with sternum *st2* ..... *H. himalayae*

13. Most dorsal setae medium in length, as long or nearly as long as genu I, but shorter than tibia I 14
All dorsal setae extremely minute, shorter than genu I 16

14. Leg III seta *tal6* spatulate; sternum *st3* expanded posteriorly ..... *H. cyrtandrae*
Leg III seta *tal6* tapering; sternum *st3* thin and not expanded 15

15. Dorsal propodosoma with three transverse striations, giving sculptured effect; pedipalpal setae *pp1* fine, approximately equal in length to fused pedipalps ..... *H. sextoni*, sp. nov.
Dorsal propodosoma with two transverse striations; pedipalpal setae *pp1* much longer than fused pedipalps ..... *H. julorum*

16. Propodosoma without transverse striations; sternum *st1* continuous with apodemata *a4* 17
Propodosoma with transverse striations, giving sculptured effect; sternum *st1* not continuous with apodemata *a4* 18

17. Sternum *st2* continuous with apodemata *a4* and *a5* and with faint rounded expansion in middle ..... *H. polaki*

Sternum *st2* not continuous with apdoemata *a4* and *a5* and without expansion in middle ..... *H. polypori*

18. Fused pedipalps equal in length or shorter than genu I ..... *H. feroniarum*
Fused pedipalps longer than genu I 19

19. Apodemata *a4* not continuous in midline; *st3* and *st4* not contiguous ..... *H. humiditatis*
Apodemata *a4* faintly continuous in midline; sternum *st3* and *st4* not contiguous ..... *H. bakeri*, sp. nov.

20. Tapering membranous claw base ..... *H. piloseta* sp. nov.
Claw base not tapering 21

21. Dorsal setae unequal in length 22
Dorsal setae approximately equal in length 26

22. All dorsal hysterosomal setae minute; distinctly shorter than propodosomal setae ..... *H. crassipes*
All dorsal hysterosomal setae not minute; not equal in length 23

23. Dorsal setae medium in length, and nearly equal except setae *do3*, *do4*, and *do6* ..... *H. trichophorus*
Dorsal setae not all medium in length; size and length variable 24

24. Propodosomal seta *dp4* over twice as long as *dp3* ..... *H. cirratus*
Propodosomal seta *dp4* shorter than or equal to *dp3* 25

25. Pedipalpal seta *pp1* almost twice as long as tibia I .... *H. prodectoris*
Pedipalpal setae *pp1* approximately same length as tibia I *H. murchiei*, sp. nov.

26. Seta *ta16* leg IV longer than entire leg IV ..... *H. neglectus*
Seta *ta16* leg IV not as long as leg IV 27

27. Seta *ta16* leg IV distinctly broad and saber-like *H. banjuwangicus*
Seta *ta16* leg IV not broad and saber-like 28

28. Fused pedipalps expanded, not equal in width throughout 29
Fused pedipalps not expanded, equal in width throughout 30

29. Fused pedipalps broad at base, distinctly tapering anteriorly *H. indicus*
Fused pedipalps broader in middle, tapering anteriorly and posteriorly ..... *H. toxopei*

30. Anterior margin of dorsal hysterosoma distinctly scalloped ..... *H. crenulatus*
Anterior margin of hysterosoma not scalloped 31

31. Tarsus I shorter than combined length of other leg segments

excluding coxa 38
Tarsus I equal or longer than combined length of other leg segments excluding coxa 32

32. Seta *ta16* leg III ends in small but distinct knob ..... *H. campanula*
Seta *ta16* leg III not ending in knob 33

33. Sterna *st1*, *st2*, and *st3* faintly continuous; apodemata *a4* distinctly arched ..... *H. longipes*
Sterna *st1*, *st2* and *st3* not continuous; apodemata *a4* not distinctly arched 34

34. Apodeme *a2* making contact with *a4* ..... *H. maritimus*
Apodeme *a2* not making contact with *a4* 35

35. Apodemata *a4* not continuous in mid-region ..... *H. insularis*
Apodemata *a4* continuous in mid-region 36

36. Sternum *st2* not continuous with apodemata *a4* 37
Sternum *st2* continuous with apodemata *a4* ..... *H. litoralis*

37. Dorsal propodosoma with single anterior striation; seta *ta16* leg II distinctly spoon-like ..... *H. sapromyzarium*
Dorsal propodosoma without single anterior striation; *seta ta16* leg II flagellum-like ..... *H. berghi*

38. Tarsus I twice length of pedipalpal setae *pp1* ..... *H. prophthalmi*
Tarsus I only slightly longer than pedipalpal seta *pp1* *H. brevimanus*

GENUS *Histiostoma* Kramer, 1876

Diagnosis of genus. — Diagnosis is based on the deutonymph. Coxa I with disc *di1;* coxa III with disc *di2;* coxa IV with minute seta *vm1* mesiad of disc *di3;* suctorial plate with 2 functional suckers, 2 large central discs, and 4 discs posteriorly and laterally.

Type. — *Histiostoma feroniarum* (Dufour), 1839.

Histiostoma bakeri sp. nov.

(Plates 14, 15)

Female. — (Plate 14). Length 0.410 mm.; width 0.225 mm. *Venter.*— Chelicera serrated, bearing 7 large teeth proximally, approximately 7 minute teeth distally, and ending in a fine process bearing a distinct knob. Cheliceral flagellum nearly twice as long as toothed portion. Seta *pp1* three times as long as *pp2*. Pedipalp bears extremely fine bristles

distally on membranous structure. Posterior ringlike structure *r2* distally elongated, nearly shoe-shaped. Setae generally shorter than in *H. julorum*. Seta *vm3* lateral to posterior ringlike structure; *vo3* slightly longer than *vo2; vo1* minute. *Dorsum.* — Dorsum finely granular, and sometimes

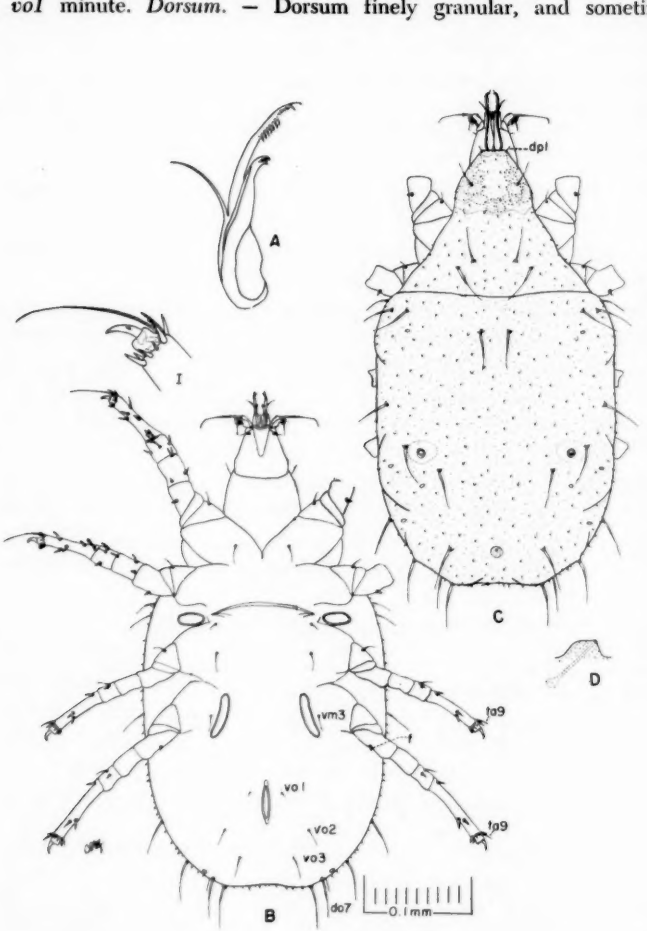

Plate 14 — *Histiostoma bakeri* sp. nov. female. A — chelicera. B — venter. C — dorsum. D — bursa copulatrix.

with minute pointed projections appearing to be cuticular in origin, which vary in number and distribution. These projections give a fuzzy appearance. Rostrum is faintly sculptured. Seta *dp1* minute; other setae similar to those of *H. julorum*. Bursa copulatrix distinctly raised, heavily granular, and with minute anterior opening. *Legs.* — Leg shape, setae size and arrangement are generally similar to *H. julorum*. Outstanding differences are the short, spine-like femoral seta of leg IV, and the slightly longer terminal tarsal setae *ta9* of legs III-IV of *H. bakeri*.

Male. — This species is thelytokous.

Deutonymph. — (Plate 15). Length 0.174 mm.; width 0.120 mm. *Venter.* — Fused pedipalps slightly longer than tibia I; seta *pp1* nearly equal in length to tarsus II. Sternum *st1* free; apodemata *a2* join *a4* which latter are faintly continuous in midline; sternum *st2* not united with *a4*, and *st3* and *st4* contiguous. By comparison with *H. julorum* discs *pd1* are smaller. *Dorsum.* — Dorsum smooth except for single line of sculpturing on the anterior propodosoma, and faint transverse striations on the anterior margin of the hysterosoma. Setae minute, hairlike, and equal in length. *Legs.* — Seta *ta16* leg I nearly cup-shaped; *ta16* leg II lancet-shaped; *ta16* leg III tapering. Seta *ta3* leg I over one-half as long as tarsus I; *ta4* longer than *ta1*.

Remarks. — The combination of adult characteristics most useful in identifying this species is length of seta *pp1;* the minute terminal knob on the chelicera; presence of pedipalpal bristles; elongated posterior ring-like structures; seta *vm3* laterad of *r2*. The deutonymph is very similar to that of *H. feroniarum* and *H. humiditatis* and can be distinguished from these only with difficulty (see key). This species is named in honor of Dr. Edward W. Baker.

Collections. — Collected by R. D. Hughes at Norris Dam, Tenn., July 1951; by Ronald D. Jones in swamp near rotting logs, Woodlawn, Va., June 1952; by R. D. Hughes in dung near Ellerson, Va., Sept. 1954; by A. H. O'Bier north of River Road, 9 miles west of Richmond, Va., Sept. 1954.

Types. — Holotype female and paratypes in U. S. National Museum, Washington, D. C. Paratypes located as follows:

U. S. National Museum, Washington, D. C.

British Museum of Natural History, London, England.

Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands

Museum National d'Histoire Naturelle, Paris, France

The South Australian Museum, Adelaide, South Australia

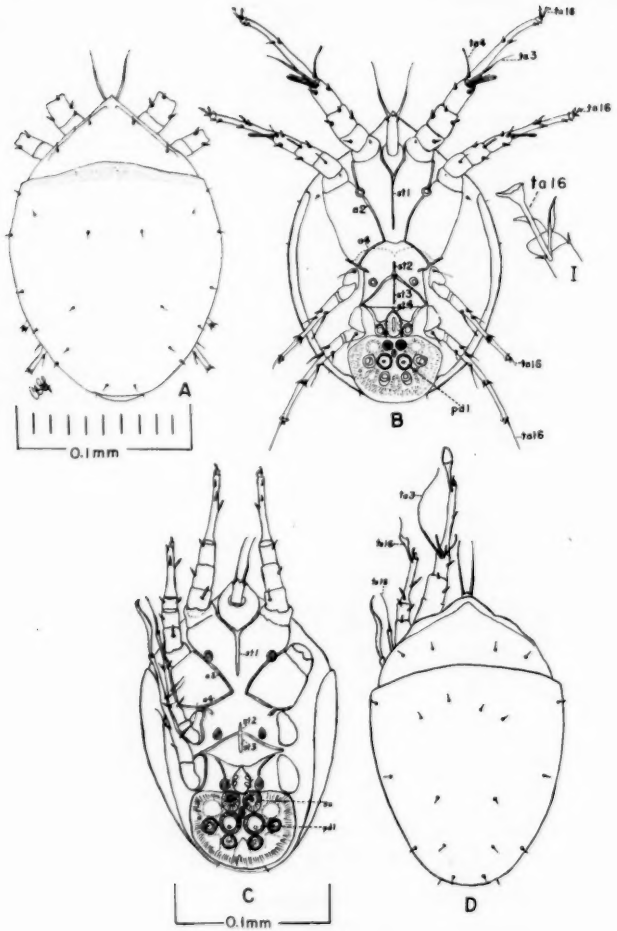

Plate 15 – Upper, *Histiostoma bakeri* sp. nov. deutonymph, A – dorsum, B – venter. Lower, *Histiostoma banjuwangicus* deutonymph. C – venter. D – dorsum. (Original unpublished drawing by A. C. Oudemans).

Natal Museum, Pietermaritzburg, Union of South Africa
National Collection, Ottawa, Canada
USSR Academy of Science, Moscow and Leningrad, USSR
Musee Royal d'Histoire Naturelle de Belgique, Brussels, Belgium

Histiostoma banjuwangicus (Oudemans), 1911

(Plate 15)

Anoetus banjuwangicus Oudemans, 1911; *Histiostoma banjuwangicus* (Oudemans), 1911 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 15). Length 0.186 mm.; width 0.124 mm. *Venter.* — Fused pedipalps equal to genu I, seta *pp1* twice length of genu I; sternum *st1* free; *st2* and *st3* short. Apodeme *a2* unites with *a4*. Suctorial plates distinctly large. Functional sucker *su* nearly as large as central plate disc *pd1*. *Dorsum.* — Dorsum non-granular; setae minute, hairlike. Anterior margin of propodosoma undulating. *Legs.* — Seta *ta3*, leg I longer than tarsus I. Seta *ta16*, leg II, lancet-like. Seta *ta16* leg III long, tapering. Leg IV with "saber-shaped end hair."

Remarks. — Oudemans does not show a claw on leg III, which, if not an omission, is atypical for anoetids. It is possible that the "end hair" of leg IV represents a modified claw as described for *A. laboratorium*. Seta *vm1* and several dorsal setae and leg setae are not shown.

Collections. — One specimen from a blattid with hard abdomen, Banjoewangi, Java, 1910, by D. MacGillavry.

Types. — Holotype in Oudemans' collection.

Histiostoma berghi Jensen, 1895

(Plates 16, 17)

Female. — (Plate 16). Length 0.770 mm.; width 0.450 mm. *Venter.* — Chelicera finely serrated, teeth equal. Pedipalpal seta *pp1* equal to tibia I; *pp2* very minute. Ringlike structures *r1* and *r2* small and round; *r1* is more mesially placed than in *H. julorum*. The bursa copulatrix is conical in shape, and is sub-marginal rather than dorsal in position. *Dorsum.* — Smooth; rostrum heavier than for male. *Legs.* — Legs I-II

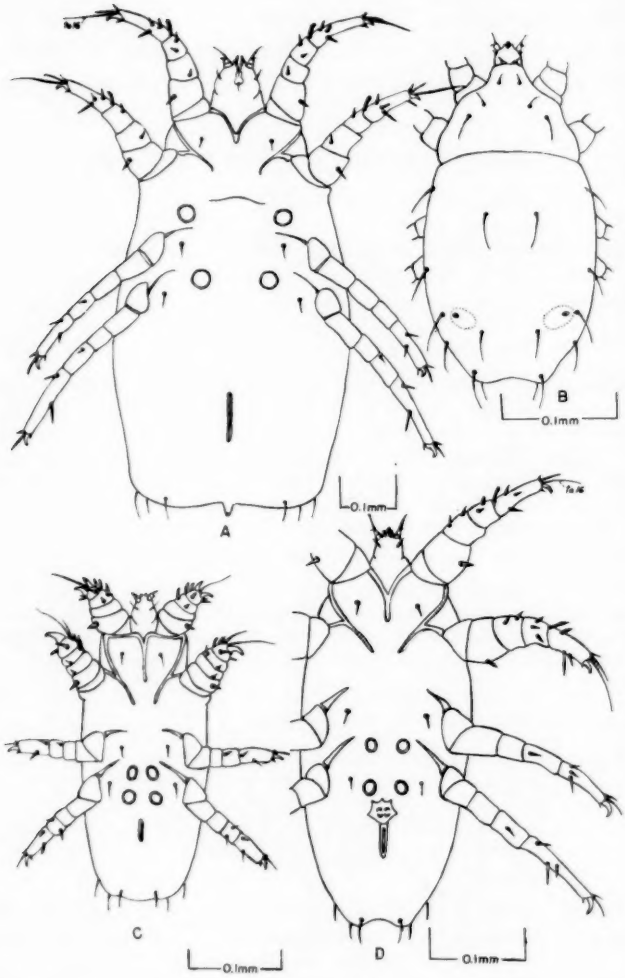

Plate 16 – *Histiostoma berghi*. A – female, venter. B – protonymph, dorsum. C – tritonymph, venter. D – male, venter. (From Jensen)

heavier than legs I-II-IV. Legs III-IV with terminal setae, twice as long as claw.

Male. — (Plate 16). Length 0.390 mm.; width 0.185 mm. *Venter.* — Body elongated. Ringlike structures *r1* and *r2* nearly round, arranged in a square, and lie above the external genitalia. Dorsal setae assumed to be similar to that of protonymph (Plate 16). *Dorsum.* — Smooth. *Legs.* — Seta *ta16* leg I more than half as long as in female. Femur leg II unusually heavy. Relative leg size, arrangement, and type of setae similar to female. Terminal seta legs III-IV longer than claw.

Deutonymph. — (Plate 17). Length 0.250 mm.; width 0.163 mm. *Venter.* — Fused pedipalps equal to tibia I. Seta *pp1* twice length of tibia I. Sternum *st1*, and apodeme *a2* long and free. Apodemata *a4* continuous in midline. Sternum *st2* not continuous with *a4*. Suctorial plate distinctly large. *Dorsum.* — On the basis of incomplete description, dorsum assumed to be smooth; setae small and equal in length. *Legs.* — Seta *ta3* leg I one-half length of tarsus I; seta *ta4* nearly as long as *ta1*. Seta *ta16* tarsus II long, tapering, and equal in length to *ta16* legs III-IV.

Tritonymph. — (Plate 16). Length 0.316 mm.; width 0.132 mm. Ringlike structures *r1* and *r2* similar in arrangement to the tritonymph of *H. julorum*. Legs I-II shortened and enlarged in contrast to legs III-IV, and distinctly shorter than is typical for other anoetid species. Tarsal setae of legs I-II usually spine-like.

Remarks. — The dorsal setal pattern of all species of protonymphs examined closely indicates that this pattern is the same for the adult male. Hence, it is assumed that such is the case for this species and that some few setae were overlooked. Jensen believed that the stout legs I-II of the tritonymph were modified for the purpose of boring into a cocoon and records one instance in which this was actually observed. (See *H. murchiei* under remarks). Apparently Jensen failed to observe a considerable number of setae on the body and legs. Comparison of *H. berghi* with *H. murchiei* is invited since these are the only two species which are known to be parasitic or semi-parasitic, both feeding on the eggs or larva in the cocoons of annelids. Females of both species are usually large, have distinctly round anterior ringlike discs *r1*, and a nearly marginal bursa copulatrix. Both species are remarkable for the extremely small gnathosoma and delicate gnathosomal structures in the adult. The dissimilarity of the deutonymphs of *H. murchiei* and *H. berghi* is quite striking, and the possibility exists that the deutonymph of *H. berghi* is not correctly associated with the adults of this species.

Collections. — From the beach of a pond near Copenhagen, all stages in cocoons of the horse leech, *Aulastoma gulo*.

Types. — No record.

Histiostoma brevimanus (Oudemans), 1914

(Plate 18)

Lipstorpia brevimanus Oudemans, 1914; *Anoetus brevimanus* Oudemans, 1917; *Histiostoma brevimanus* (Oudemans), 1917 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 18). Length 0.155 mm.; width 0.111 mm. Color light yellow-brown. *Venter.* — Fused pedipalps equal to genu I. Seta *pp1* twcie length of genu I. Sternum *st1* and apodeme *a2* ending free. Apodemata *a4* continuous in midline and joined to *st2*. Functional suckers *su* and all proximal discs approximately equal in diameter. *Dorsum.* — Ellipsoid. Finely striped longitudinally. All setae extremely minute. *Legs.* — Tarsus I relatively short in comparison with other species. All

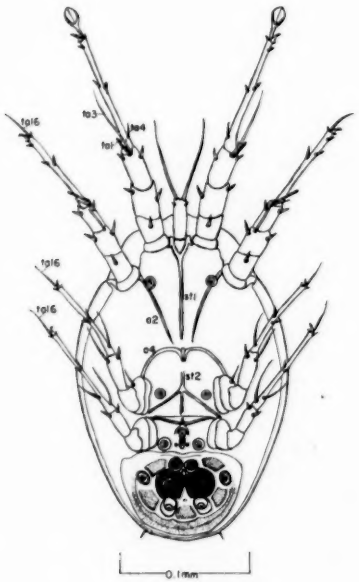

Plate 17 — *Histiostoma berghi* deutonymph, venter. (From Jensen)

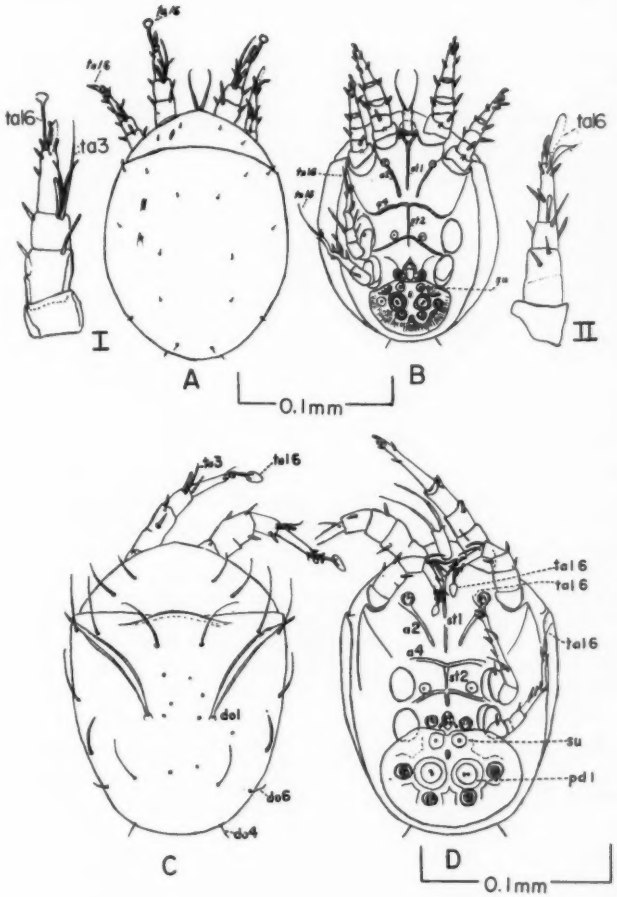

Plate 18 — Upper, *Histiostoma brevimanus* deutonymph. A — dorsum. B — venter. Left — leg I. Right — leg II. (Original unpublished drawing by A. C. Oudemans) Lower, *Histiostoma ensifer* deutonymph. C — dorsum. D — venter (Original unpublished drawing by A. C. Oudemans)

legs shorter than typical. Seta *tal6* leg I spoon-shaped; *tal6* leg II lancet-shaped; *tal6* leg III tapering, shorter than *tal6* leg IV. Seta *ta3* longer than tarsus I.

Remarks. — Description based on a single imperfect specimen. Certain body and leg setae apparently inadvertently omitted.

Collections. — One specimen in a hot bed, Sittard, Netherlands, May 1912; collected by F. Heselhaus.

Types. — In Oudemans' collection.

Histiostoma campanula (Oudemans), 1914

(Plate 19)

Anoetus campanula Oudemans, 1914; *Histiostoma campanula* (Oudemans), 1914 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 19). Length 0.211 mm.; width 0.140 mm. *Venter.* — Fused pedipalps equal to genu I. Seta *pp1* equal in length to tarsus II. Sternum *st1* long and free. Apodemata *a2* nearly joining with *a4*, which latter are faintly membranous in midline. Sternum *st2* Y-shaped anteriorly. Coxal discs *di1* and *di2* definitely smaller than *di3*. *Dorsum.* — Smooth; pear-shaped; pedipalpal base extending beyond the anterior margin of propodosoma. Setae minute and hairlike. *Legs.* — Seta *tal6* leg I cup-shaped; *tal6* leg II lancet-shaped; *tal6* leg III twice as long as claw. Tarsus I seta *ta3* only slightly longer than *tal;* femoral setae *f* legs I-II and trochanter seta *t* leg III distinctly longer than corresponding setae of *H. julorum*.

Remarks. — Only deutonymph of *H. fimetarium* is as distinctly pear-shaped as this species. The minute knob on the end of seta *tal6* leg III, if correctly described, is unique among the anoetids. All body and leg setae apparently not observed by Oudemans.

Collections. — Banjoewangi, Java, 1911; by D. MacGillavry.

Types. — Holotype in Oudemans' collection.

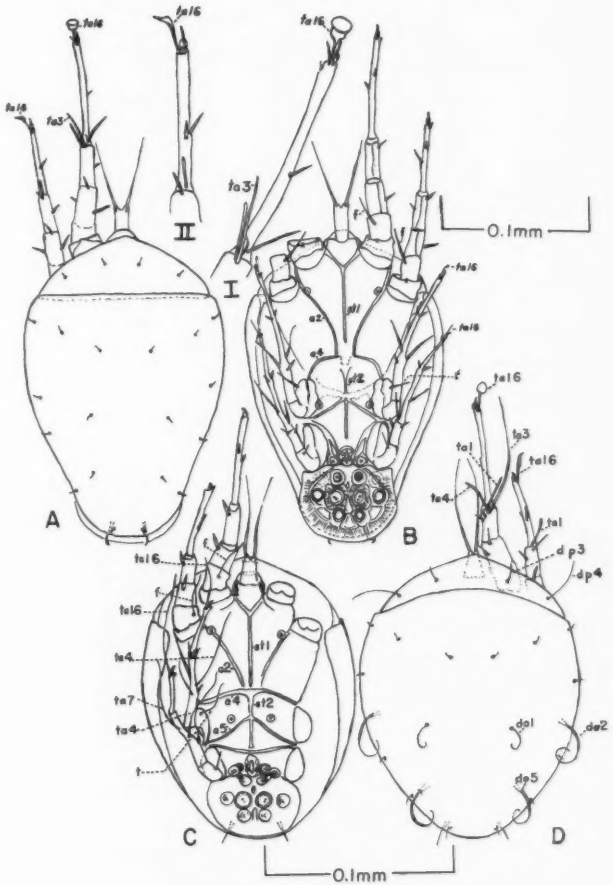

Plate 19 — Upper, *Histiostoma campanula* deutonymph. A — dorsum. B — venter. (Original unpublished drawing by A. C. Oudemans) Lower, *Histiostoma cirratus* deutonymph. C — venter. D — dorsum. (Original unpublished drawing by A. C. Oudemans)

Histiostoma cirratus (Oudemans), 1911

(Plate 19)

Anoetus cirratus Oudemans, 1911; *Histiostoma cirratus* (Oudemans, 1911) [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 19). Length 0.150 mm.; width 0.115 mm. *Venter.* — Fused pedipalps slightly tapering distally; equal in length to genu I. Seta *pp1* equal in length to tarsus I. Sternum *st1*, and apodeme *a2* touching or nearly touching *a4*. Apodemata *a4* strong, continuous in midline. Sternum *st2* united with *a4* and *a5*. *Dorsum.* — Smooth; setae variable in length; seta *dp4* over twice as long as *dp3;* seta *do2* and *do5* longer than *dp4* and curly; seta *do1* shorter than *dp4* and curly; other setae minute and hairlike. *Legs.* — Tarsus I seta *ta16* spoon-shaped; seta *ta16* leg II lancet-shaped; seta *ta16* leg III tapering, longer than *dp4;* *ta16* leg IV hairlike, longer than *pp1*. Seta *f* legs I-II, and seta *t* leg III equal in length to *dp4*. Seta *ta3* leg I longer than tarsus I; *ta4* leg I equal in length to *ta1*. Seta *ta4* leg III, *ta4* and *ta7* leg IV extremely long and hairlike.

Remarks. — This species is unusual in that it has a large number of extremely long leg setae, and that in general there is extreme variability in size and type of leg and body setae. The full complement of leg setae is not shown.

Collections. — 2 specimens from a blattid with hard abdomen, Banjoewangi, Java; collected by D. MacGillavry in 1910.

Types. — Holotype in Oudemans' collection.

Histiostoma crassipes (Oudemans), 1912

(Plate 20)

Anoetus crassipes Oudemans, 1912; *Lipstorpia crassipes* Oudemans, 1914; *Histiostoma crassipes* (Oudemans), 1914 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 20). Length 0.190 mm.; width 0.120 mm.; color light brown. *Venter.* — Fused pedipalps slightly separated, wide at

base and tapering distally. Seta *pp1* equal in length to tarsus II. Sternum *st1* and apodemata *a2* free but converging near midline. Apodemata *a4* and *st2* faintly united in midline. *Dorsum.* — Smooth. Hysterosomal setae minute, hairlike, and equal in length. Seta *dp3* twice as long as *dp4; dp4* equal in length to tibia I. *Legs.* — Seta *ta16* leg I-II spoon-shaped; legs III-IV without long tapering seta *ta16*. Femur I-II short; seta *f* legs I-II, and *t* leg III three times as long as corresponding setae in *H. julorum*. Genu I and tibia I enlarged; genu and tibia I-II setae stout, spine-like; tarsus I seta *ta3* equal in length to tarsus II. Tarsus IV seta *ta4* equal in length to *pp1*.

Remarks. — The unusual structure of legs I-II was interpreted by Oudemans and Vitzthum (1923) as a fusion of genua and femurs. The presence of a typical seta *f* indicates that the true femur is foreshortened, and that the genu is correspondingly enlarged and pseudosegmented. A full typical complement of leg setae is not shown. Oudemans (1914a) placed this species in the genus *Lipstorpia*, but in 1917 returned it to *Anoetus*.

Collections. — Borne on *Platypus dispar* Schauff II (Platypodidae) in a forest at 1000 meters altitude on Mikulumusi Mountain, and 2 specimens on *Hololepta africana* Lew. (Histeridae), Amani, Dutch East Africa, July 1911; discovered by Vitzthum on *Ips stebbingi* Strohmeyer in collection by H. Wichmann from Kutu, Himalaya.

Types. — Holotype in Natural History Museum, Hamburg, Germany.

Histiostoma crenulatus (Oudemans), 1909

(Plate 20)

Anoetus crenulatus Oudemans, 1909; *Histiostoma crenulatus* (Oudemans), 1909 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 20). Length 0.195 mm.; width 0.157 mm. *Venter.* — Fused pedipalps equal in length to genu I. Seta *pp1* equal in length to tarsus II. Sterna *st1*, *st2*, and *st3* united. Apodemata *a2* end anteriorly at disc *di1*, and join *a4* posteriorly. Apodemata *a4* distinctly continuous in midline. Seta *vm1* described but not shown in drawing. *Dorsum.* — Smooth, except anterior margin of hysterosoma distinctly crenulated. Setae minute, hairlike, and equal. Propodosoma shortened. *Legs.* — Seta *ta16* legs I-II distinctly large, lancet-shaped; *ta16* leg III unstalked, oval, smaller than *ta16* leg II; distal tarsal seta leg IV tapering, twice length of *pp1*. Other setae leg IV generally short, spine-like.

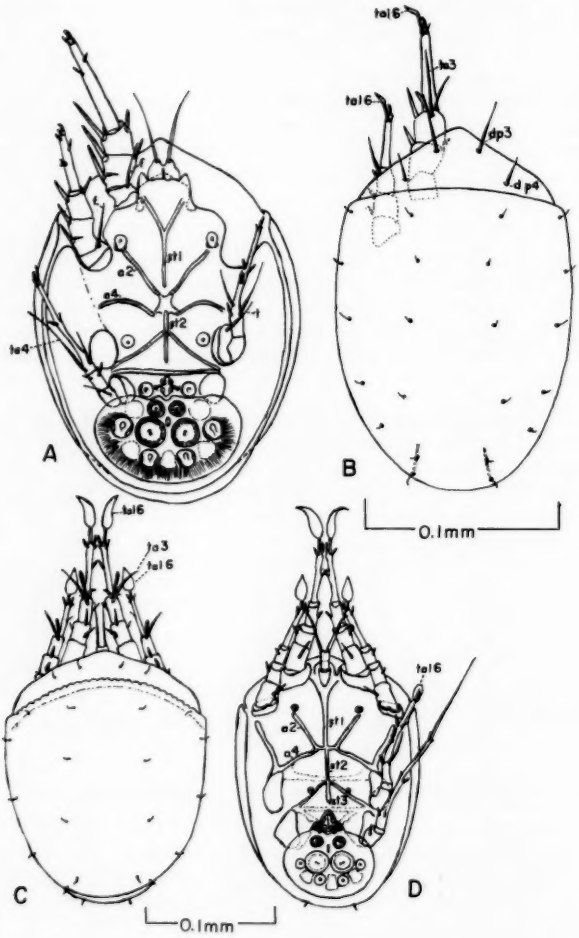

Plate 20 — Upper, *Histiostoma crassipes* deutonymph. A — venter. B — dorsum. (Original unpublished drawing by A. C. Oudemans) Lower, *Histiostoma crenulatus* deutonymph. C — dorsum. D — venter. (Original unpublished drawing by A. C. Oudemans)

Seta *ta3* leg I equal in length to *pp1*.

Remarks. — Oudemans (1924c) erroneously identified *Hypopus setipes* Koch, 1847 as *H. crenulatus*. He corrected this misidentification in 1937. Crenulation of hysterosoma and oval seta *ta16* leg III are very distinctive. Full typical complement of leg setae not shown.

Collection. — On *Necrophorus vespillo* from Arnhem, Netherlands, Sept. 1909.

Types. — Holotype in Oudemans' collection.

Histiostoma cyrtandrae (Vitzthum), 1931, new combination

(Plate 21)

Anoetus cyrtandrae Vitzthum, 1931.

Female. — (Plate 21). Length 0.420 mm.; width 0.230 mm. *Venter.* — Chelicera finely serrated, bearing approximately 30 fine teeth of equal size; cheliceral flagellum shorter than toothed area. Seta *pp1* medium in length, over twice as long as *pp2*. Anterior ringlike structures nearly shoe-shaped; posterior ringlike structures distinctly elongated. Setae similar in size and arrangement to *H. julorum*, except *vm3* is mesiad of *r2*, and *vo3* is much longer. *Dorsum.* — Dorsum finely granular or with tiny points. Rostrum heavily granular and mildly sculptured. Except *dp1*, *dp2*, and *dp3* dorsal setae over twice as long as *pp1*, and slightly variable in length and thickness. The bursa copulatrix is on a line with setae *do1*, a position more anterior than is typical, and bearing an anterior boss. *Legs.* — The leg setae are generally heavier than *H. julorum*. Long tapering terminal tarsal setae *ta9* are present on legs III-IV. All claws are heavier than in *H. julorum*.

Male. — This species is thelytokous.

Deutonymph. — (Plate 21). Length 0.198 mm.; width 0.138 mm. *Venter.* — Fused pedipalps slightly longer than tibia I; *pp1* nearly as long as tarsus II. Sternum *st1* meets the faintly connected *a4;* apodeme *a2* faintly connected to *a4*. Sternum *st3* expanded posteriorly and faintly joined to *st4*. *Dorsum.* — Propodosoma pointed anteriorly with faint transverse sculpturing; anterior margin of hysterosoma transversely striated. Lateral margins of the hysterosoma sometimes appear to be faintly sculptured. Dorsal setae only slightly variable in length, hairlike, and generally equal in length to genu I. *Legs.* — Seta *ta3* leg I over one-half as long as tarsus I; setae *f* legs I-II, and IV, and seta *t* leg III shorter than in *H. julorum*. Seta *ta4* leg III spine-like. Seta *ta16* leg I elongated, spoon-shaped; *ta16* leg II lancet-shaped, *ta16* leg III spatulate, *ta16* leg

IV long, tapering with rounded end.

Remarks. — The combination of adult characteristics most useful in identifying this species is: the heavy but finely serrated chelicera, the medium length of the pedipalpal seta *pp1*, the elongated posterior ring-like structures, seta *vm*3 mesiad of *r2;* strong, elongated, dorsal setae and claws. For the deutonymph, length of pedipalp and seta *pp1*, arrangement of apodemata, transverse striations on anterior dorsal hysterosoma, medium hairlike dorsal setae, and shape of *ta16* all legs, especially leg III which is uniquely spatulate. Vitzthum did not describe the deutonymph. It is worthy of note that this is one of the two *Histiostoma* species known to thrive completely submerged. Both were collected by R. F. Nigrelli in the same goldfish tank on different dates. This species has been cultured on moist housefly media in this laboratory for over two years, indicating that it tolerates submergence but does not require it. Not attempt was made to culture the other species, *H. nigrellii,* on housefly media, and it was subsequently lost (see below). It is also of interest that both species have been associated with the death of fish. R. F. Nigrelli in a personal communication states that a preliminary investigation indicates that some unidentified toxic substance is given off by these mites which is lethal to guppies and goldfish. If this observation is confirmed it will be the first known instance of an anoetid giving off a toxic substance. Since other lethal agents were not entirely ruled out by Nigrelli's observations, it appears quite possible that the mites were simply scavengers associated with fish whose death was due to an unknown cause.

Collections. — One adult female and one tritonymph in the axil fluid of an Aracae, *Colocasia indica,* near the sea of Ngebel, in middle Java, Dec. 1928. One adult female and great numbers of protonymphs and tritonymphs in the water filled bases of the flower, *Cytandra glabra,* in a forest near Ranau, southern Sumatra, March, 1929. (Vitzthum 1931). In a goldfish tank at the Aquarium, New York Zoolological Society, October, 1954. Collected by Ross F. Nigrelli.

Types. — Holotype probably in Vitzthum's collection. Plesiotypes (supplied by present authors) as follows:

U. S. National Museum, Washington, D. C.

British Museum of Natural History, London, England

Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands

Museum National d'Histoire Naturelle, Paris, France

The South Australian Museum, Adelaide, South Australia

Natal Museum, Pietermaritzburg, Union of South Africa

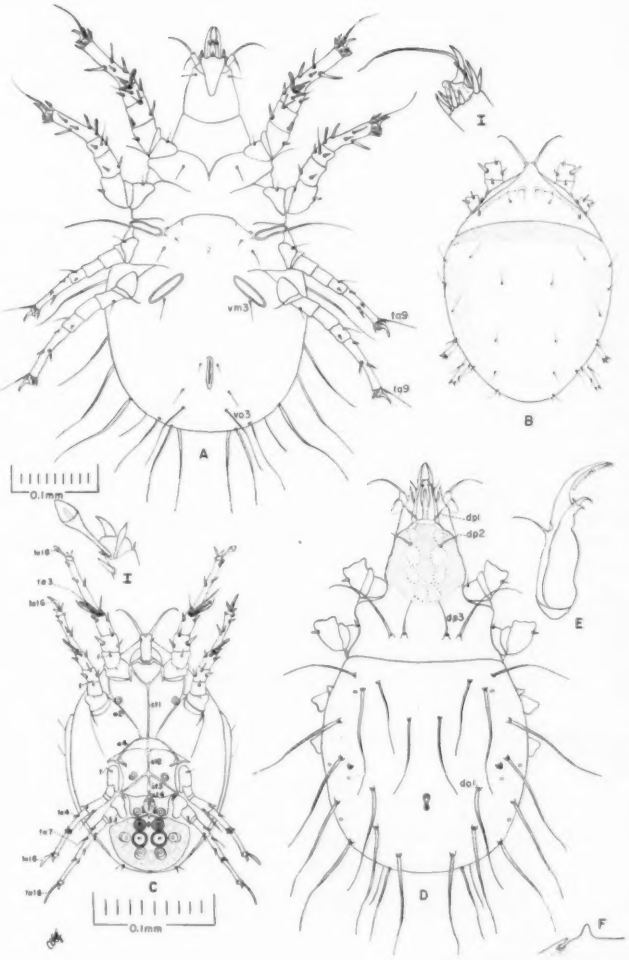

Plate 21 — *Histiostoma cyrtandrae*. A — female, venter. B — deutonymph, dorsum. C — deutonymph, venter. D — female, dorsum. E — chelicera. F — bursa copulatrix.

National Collection, Ottawa, Canada
USSR Academy of Science, Moscow and Leningrad, USSR
Musee Royal d'Histoire Naturelle de Belgique, Brussels, Belgium

Histiostoma ensifer (Oudemans), 1912

(Plate 18)

Anoetus ensifer Oudemans, 1912; *Histiostoma ensifer* (Oudemans), 1912 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 18). Length 0.135 mm.; width 0.096 mm. *Venter.* — Fused pedipalps equal in length to tibia I. Seta *pp1* nearly equal in length to tarsus I. Sternum *st1* and apodeme *a2* end free. Apodemata *a4* united with *st2*, and continuous in midline. Suctorial plate distinctly large. *Dorsum.* — Hysterosoma faintly pitted. One pair of strong saber-shaped setae *do1*. Remainder of setae variable in length, hairlike, and except for *do4* and *do6* shorter than tibia I. *Legs.* — Seta *ta16* legs I-II spoon-shaped; *ta16* leg III hairlike, twice as long as claw. Seta *ta16* leg IV hairlike and twice as long as *ta16* leg III. Seta *ta3* leg I half as long as tarsus I.

Remarks. — Anterior fold of hysterosoma may be artifact according to Oudemans. Seta *ta16* leg II indistinctly spoon-shaped. Oudemans states that discs *di1* and *di3* are heavier and more distinct than *su* and *pd1*. A few of the typical complement of leg setae and two body setae are not shown.

Collections. — One specimen on Passilide in Amani, Dutch East Africa, August 1911.

Types. — Holotype in Natural History Museum in Hamburg, Germany.

Histiostoma feroniarum (Dufour), 1839

(Plates 22, 23)

Hypopus feroniarum Dufour, 1839; *Tyroglyphus feroniarum* (Dufour), 1839 [Moniez, 1893]; *Anoetus feroniarum* (Dufour), 1839 [Oudemans, 1897]; *Histiostoma feroniarum* (Dufour), 1893 [Canestrini, 1899]; *Hypopus dugesi* Claparede, 1868; *Anoetus dugesi* (Claparede), 1868 [Oude-

mans, 1909]; *Tyroglyphus rostro-serratus* Megnin, 1873; *Histiostoma rostro-serratus* (Megnin), 1873 [Berlese, 1881]; *Histiostoma rostro-serratum* (Megnin), 1873 [Jary and Stapley, 1936]; *Rhizoglyphus rostro-serratus* Murray, 1877; *Acarus mammillaris* Canestrini and Fanzago, 1876; *Phyllostoma pectineum* Kramer, 1876; *Histiostoma pectineum* Kramer, 1876; *Serrator amphibius* Megnin, 1880; *Histiostoma americanum* Banks, 1906; *Histiostoma gracilipes* Banks, 1906.

Female. — (Plate 22). Length 0.250 mm.; width 0.300 mm. *Venter.* — Chelicera serrated with seven large teeth proximally, approximately six minute teeth distally, and ending in a distinct bristle. Chelicercal flagellum longer than in *H. julorum*. Distinct membranous structure associated with the pedipalp. Seta *pp1* slightly longer and heavier than *pp2*. Anterior ringlike structure *r1* typically elongate; *r2* typically round or oval. Setae short, hairlike and nearly equal except for *vm1*. Seta *do7* ventral instead of dorsal or marginal. *Dorsum.* — Rostrum sculptured; dorsum finely granular. Setae similar in size and arrangement to *H. julorum* except for *dp1*. Bursa copulatrix raised, heavily granular, and opening anteriorly. *Legs.* — Shape, size, and setae arrangement similar to *H. julorum* except seta *ti2* legs I-II over three times longer than other tibial setae; trochanter setae legs I-III, and femoral seta leg IV shorter.

Male. — (Plate 22). Length 0.362 mm.; width 0.230 mm. Body more shield-shaped, less elongated than *H. julorum*. *Venter.* — Gnathosoma as in female. Ringlike structures nearly round and arranged in a square above the external genitalia. Setae nearly equal; generally shorter, but similar in arrangement to *H. julorum* except *vm1* lateral to *r1; vo1*, *vo2*, and *vo3* are borne on a distinct genital plate which surrounds the anus and external genitalia. Seta *do4* marginal in position; pit-like structure *dpi4* is ventral. *Dorsum.* — Rostrum faintly sculptured; dorsum finely granular. Dorsal setae similar in size and arrangement to *H. julorum* except: *dp1* shorter, *dp2* longer, and *do4* ventral. *Legs.* — Legs more robust; setae generally heavier, especially tarsus II setae, than in *H. julorum*. Seta *ta8* leg II about as stout as claw, a feature unique for this species. Setae *ti2* legs I-II, trochanter setae *t* legs I-III, and femoral seta *f* leg IV as in female.

Deutonymph. — (Plate 23). Length 0.178 mm.; width 0.130 mm. *Venter.* — Fused pedipalps equal in length to genu II; seta *pp1* equal to tarsus II. Sternum *st1* free; apodemata *a2* barely touching *a4;* apodemata *a4* faintly continuous in midline; *st2* free; coxal discs *di1* and *di2* smaller than *di3*. *Dorsum.*—Dorsum smooth except for the single line of transverse sculpturing on propodosoma and transverse striations on anterior margin of the hysterosoma. Setae minute, hairlike, and equal. *Legs.*—*Seta ta16* leg I spoon-shaped; *ta16* leg II lancet-shaped; *ta16* leg III tapering, three times as long as claw; *ta16* leg IV tapering, four times as long as

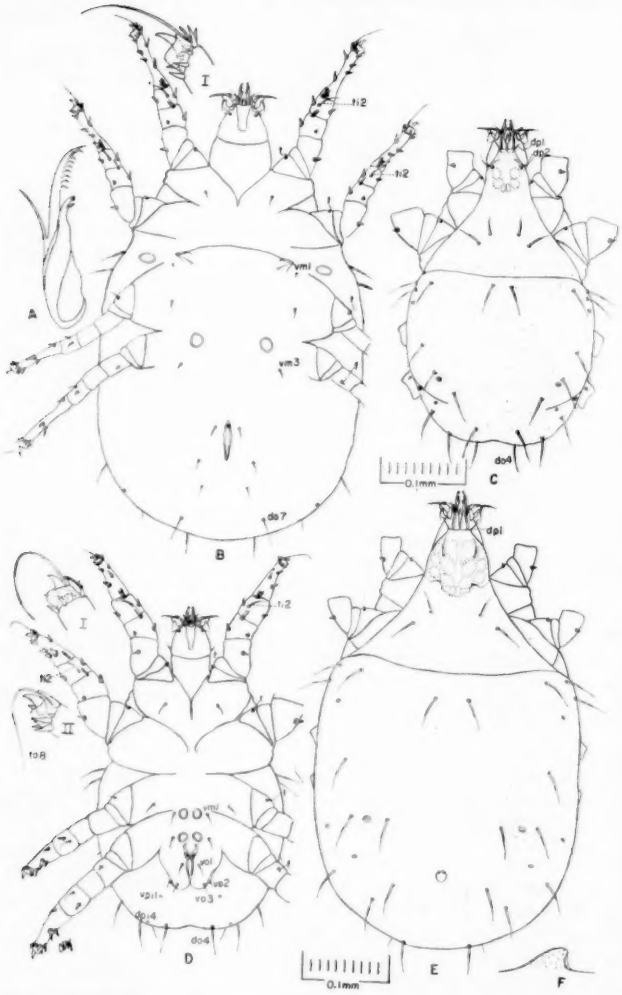

Plate 22 – *Histiostoma feroniarum*. **A** – chelicera. **B** – female, venter. **C** – male, dorsum. **D** – male, venter. **E** – female, dorsum. **F** – bursa copulatrix.

claw. Seta *ta4* leg I with rounded end. Seta *ta3* leg I equal to genu II plus tibia II; *ta4* leg III, *ta4* and *ta7* shorter than in *H. julorum*.

Remarks. — This species is most remarkable in having what we provisionally regard as two distinct "varieties," one thelytokous and the other arrhenotokous. Stocks of both have been maintained in our laboratory for over five years. Morphologically the females and deutonymphs of both "varieties" are essentially indistinguishable. It appears that the thelytokous female is usually somewhat smaller than the arrhenotokous female. Observations on the chromosome numbers and cross-breeding of these two "varieties" have not been completed. The deutonymph is difficult to distinguish from *H. bakeri* and *H. humiditatis* Oudemans (1924c) synonymized this species with *H. insularis* (Oudemans), 1914. On the basis of published figures and description we have taken the position that this is an incorrect synonomy. The combination of adult characteristics most useful in identifying this species is: short but laterally directed pedipalpal setae *pp1;* membranous structures associated with pedipalps; shape of ringlike structures; and position of seta *vm3*. Different collections have yielded what appears to be slight variations in distinctness of protuberances, and ventral discs size. These variations are not considered to be sufficient evidence for the establishment of true varieties.

Collections. — This species has a wide distribution and has been found in many kinds of decaying vegetation. Collected by Dufour in exudate of Asiatic spiny tree (Feroniae) 1893; by Megnin on mushrooms in France, 1873; by Canestrini and Fanzago on fungus from Maser in Trevigiano, 1876; by Murray on potatoes in barn at Vincennes, France, 1877; by Moniez in fungus beds from Lille, France, 1893; by Megnin on mushrooms, decomposed fruit, and sauerkraut, 1880; by Kramer and Canestrini from decayed mushrooms and under tree bark, Europe, 1899; by Banks from decayed leaves, Washington, D. C., 1899; by Zacher from potato tubers in Austria, 1920; by Womersley on tiger lily, Lindfield, New South Wales, May, 1932; by Womersley from dahlia tuber, Bathurst, New South Wales, November, 1932; by Womersley in moss, Mount Barker, South Australia, June, 1934; by Jary and Stapley many collections, especially in stable manure (with *H. pyriforme*), 1936; by Womersley on milliped, Hallet, South Australia, 1938; by Womersley on rotting bulbs, Auckland, New Zealand, January, 1940. *Arrhenotokous "variety."* — Collected by R. D. Hughes in woods near Ellerson, Va., July 1950 and in compost heaps near Ellerson, Va., October and January, 1950. *Thelytokous "variety."* — Collected by Mr. John Steves in woods near Waynesboro, Va., July, 1950; by Alexander Sokaloff in oak slime flux, Mather, Calif., July, 1950; by R. D. Hughes in wooded area, Norris Dam, Tenn., July 1951; by F. C. McDowell in woods, Vernon Hill, Va., June, 1952; by R. D. Hughes in walnut hulls near Ellerson, Va., December, 1952; by A. H. O'Bier near Warsaw, Va., June,

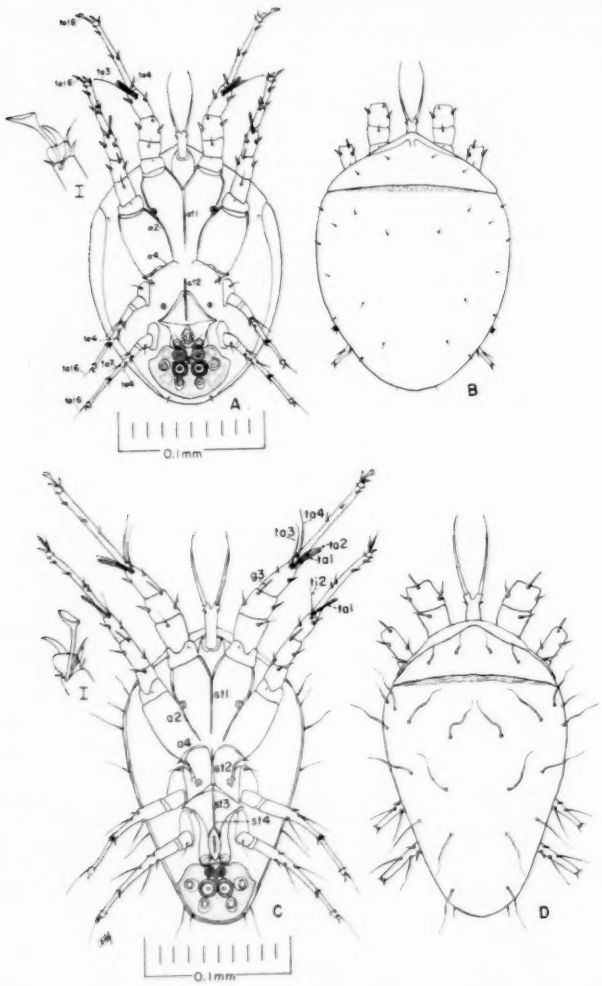

Plate 23 – Upper, *Histiostoma feroniarum* deutonymph. A – venter. B – dorsum. Lower, *Histiostoma fimetarium* deutonymph. C – venter. D – dorsum.

1954; by F. A. Robertson in moist woods near Ellerson, Va., September, 1955; by W. C. Crites south of James River near Richmond, Va., June, 1955.

Types. — Holotype no record. Plesiotypes (supplied by present authors) located as follows:

U. S. National Museum, Washington, D. C.

British Museum of Natural History, London, England

Rijksmuseum van Natuurlijke, Leiden, Netherlands

Museum National d'Histoire Naturelle, Paris, France

The South Australian Museum, Adelaide, South Australia

Natal Museum, Pietermaritzburg, Union of South Africa

National Collection, Ottawa, Canada

USSR Academy of Science, Moscow and Leningrad, USSR

Musee Royal d'Histoire Naturelle de Belgique, Brussels, Belgium

Histiostoma fimetarium Canestrini and Berlese, 1881

(Plates 23, 24)

Hypopus fimetarius Canestrini and Berlese, 1881 [Berlese, 1883]

Female. — (Plate 24). Length 0.380 mm.; width 0.225 mm. *Venter.* — Chelicera non-serrated, pointed distally; median chelicercal process not frayed or forked; cheliceral flagellum over one-half length of tarsus I; seta *pp1* nearly twice as long as tarsus I, finely tapering; *pp2* one-half as long as tarsus I. Ringlike structure *r2* elongated. Setae similar in size and arrangement to *H. julorum*, except for *vm1* which is one-half as long; *vm3* which lies laterad of *r2*; *vo1* twice as long; *vo3* one-half as long; and *do7* marginal in position. *Dorsum.* — Dorsum sometimes with minute projections giving a fuzzy appearance; rostrum heavily granular. Setae *dp1*, *dp2*, and *dp3* similar to *H. julorum*, other setae one-third longer. Bursa copulatrix raised, heavily granular, and opening anteriorly. *Legs.* — The size and arrangement of leg setae is similar to *H. julorum* except: trochanter setae legs I-III, femoral seta leg IV, and setae *ti2* legs I-II slightly longer; terminal tarsal setae slightly stouter and longer. Seta *ta2* leg I nearly equal to *ta1*.

Male. — (Plate 24). Length 0.290 mm.; width 0.140 mm. *Venter.* — Gnathosoma as in female. Ringlike structures *r2* on level with external

genitalia, round or oval, smaller and more widely separated than in *H. julorum*. Setae similar in arrangement, but generally shorter than in *H. julorum* except *vm3* is laterad and anteriad of *r2*. *Dorsum*. — Entire dorsum finely granular and sometimes with minute projections. Hysterosomal setae slightly longer than in *H. julorum*. *Legs*. — Leg setae similar in arrangement to female.

Deutonymph. — (Plate 23). Length 0.200 mm.; width 0.125 mm. Soma distinctly pear-shaped. *Venter*. — Fused pedipalps longer than tibia I; *ppl* equal to tarsus II; *st1* and *a2* free; *a4* faintly joined to *st2*; *st3* and *st4* nearly touching; *di3* posterior to trochanter IV. *Dorsum*. — Smooth, except for transverse striations on anterior margin of hysterosoma; faint membranous structure anterior to propodosoma. Propodosomal setae hairlike and equal to genu I; hysterosomal setae flexible and longer than tibia I. *Legs*. — In comparison with *H. julorum* trochanters III-IV closer to midline; leg I seta g3 longer, *ta1* and *ta2* one-half length of tarsus II, *ta4* equal to *ta3;* leg II *ti2* longer, *ta1* larger.

Remarks. — The female is readily separated from most other species on the basis of the unusually long dorsal setae, non-serrated chelicera, long *ppl*, arrangement of small, ringlike structures in the form of a trapezoid, and position of *vm3* anterio-laterad of *r2*. The deutonymph is distinctly pear-shaped with long, hairlike dorsal setae, and with distinctive, transparent membrane extending anteriorly beyond the propodosoma. Canestrini and Berlese show two anterior suckers on the venter of the male. This observation must have been in error. Repeated but unsuccessful attempts to obtain offspring from isolated virgin females have been made. It would appear that this species is not arrhenotokous. If these observations are correct it is the only species of the Anoetidae so far examined which is not parthenogenetic. This problem is receiving further study and is discussed below.

Collections. — Collected by Canestrini and Berlese from dung, Padova, Italy, February, 1881; by R. D. Hughes from Chickahominy Swamp, August and September, 1953.

Types. — Holotypes no record. Plesiotypes (supplied by present authors) in U. S. National Museum, Washington, D. C. Plesiotypes in authors' collection.

Histiostoma gladiger (Vitzthum), 1926, new combination

(Plate 25)

Anoetus gladiger Vitzthum, 1926

Female. — No information.

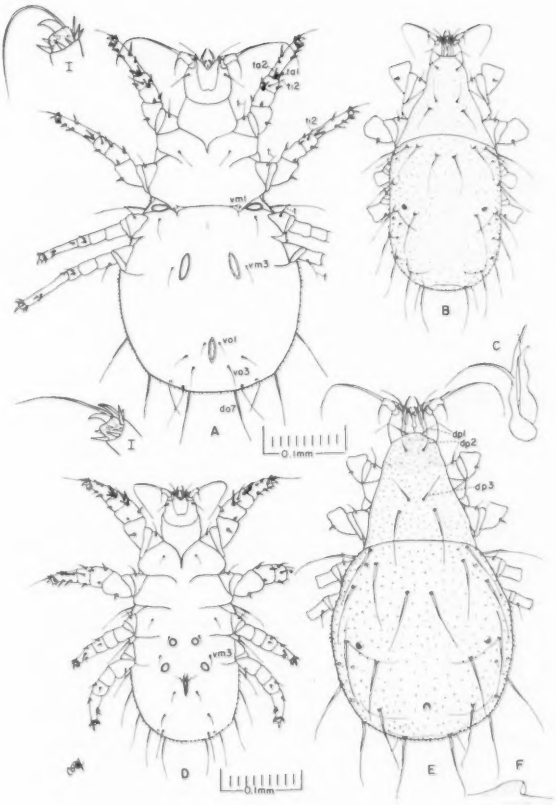

Plate 24 — *Histiostoma fimetarium*. A — female, venter. B — male, dorsum. C — chelicera. D — male, venter. E — female, dorsum. F — bursa copulatrix.

Male. — No information.

Deutonymph. — (Plate 25). Length 0.140 mm.; width 0.103 mm. *Venter.* — Fused pedipalps broad at base, equal to tarsus II; pedipalpal setae equal to fused pedipalps. Sternum *st1* and apodemata *a2* free; *a4* continuous in midline with *st2;* discs *di1* and *di2* slightly smaller than *di3. Dorsum.* — Hysterosoma granular or pitted in mid-region. Propodosomal setae not clear to Vitzthum but probably short, thick bristles. Hysterosomal setae *dm1*, *dm2*, and *do1* nearly equal and over one-half length of hysterosoma; remainder nearly equal and shorter than *dm1. Legs.* — Seta *ta16* leg I spoon-shaped; *ta16* leg II lancet-shaped; *ta16* legs III-IV long and tapering.

Remarks. — This species is based on a single specimen. Many details are lacking, including leg and dorsal setae.

Collections. — Found in insect material by H. Wichmann; collected by von Koltze on *Ips subelongatus* Motschulski, from Nikolajewsk on the mouth of the Amur.

Types. — One specimen in Vitzthum's collection.

Histiostoma gordius (Vitzthum), 1923, new combination

(Plates 25, 26)

Anoetus gordius Vitzthum, 1923

Female. — (Plate 26). Length 0.300 mm.; width 0.167 mm. *Venter.* — Chelicera not serrated, distally divided into three parts; median process of chelicera also distally divided into three parts; flagellum nearly twice as long as *H. julorum.* Seta *pp1* fine, three times longer than *pp2.* Setae generally shorter and less flexible than in *H. julorum*, otherwise similar, except: *vm1* extremely minute; *vm3* anterio-laterad of *r2; vo1* larger; *vo2* extremely fine; *vo3* equal to *vo1; do7* in a more ventral position. Ringlike structures slightly smaller but similar in shape and position to *H. julorum. Dorsum.* — Dorsum granular; rostrum and anterior-lateral margin of propodosoma sculptured. Seta *dp1* smaller than in *H. julorum, do7* ventral in position; other setae similar in size and arrangement. Bursa copulatrix on a level with seta *do4,* is only slightly raised, and opens posteriorly. *Legs.* — Trochanter setae, legs I-III are slightly shorter than in *H. julorum; ti2* legs I-II slightly longer; other setae generally the same.

Male. — (Plate 26). Length 0.240 mm.; width 0.126 mm. *Venter.* — Gnathosoma as in female. Apodeme formed by *a2* and *a3*, and sternum formed by *a1* nearly meet in midline. The ringlike structures are round or

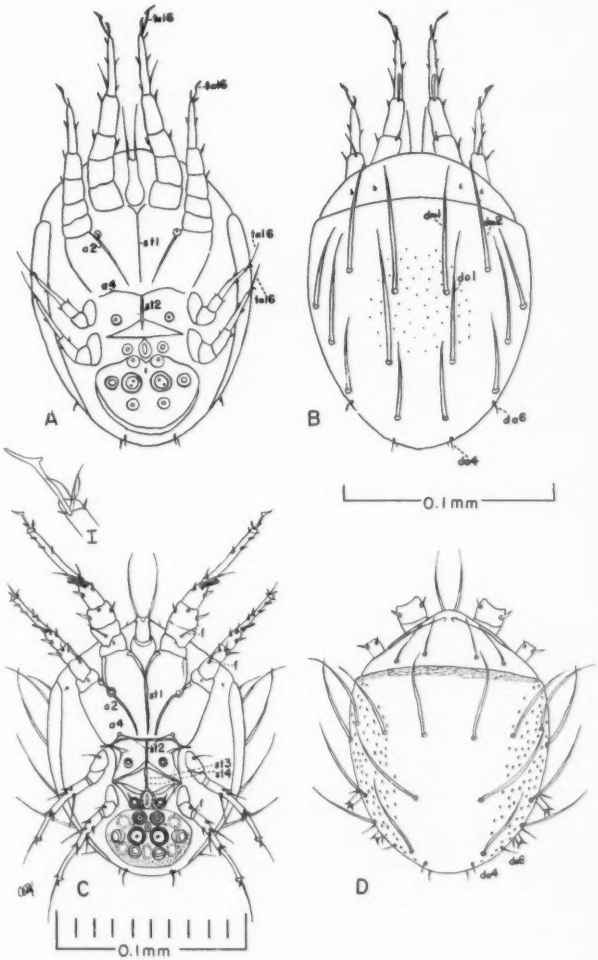

Plate 25 – Upper, *Histiostoma gladiger* deutonymph. A – venter. B – dorsum. (After Vitzthum) Lower, *Histiostoma gordius* deutonymph. C – venter. D – dorsum.

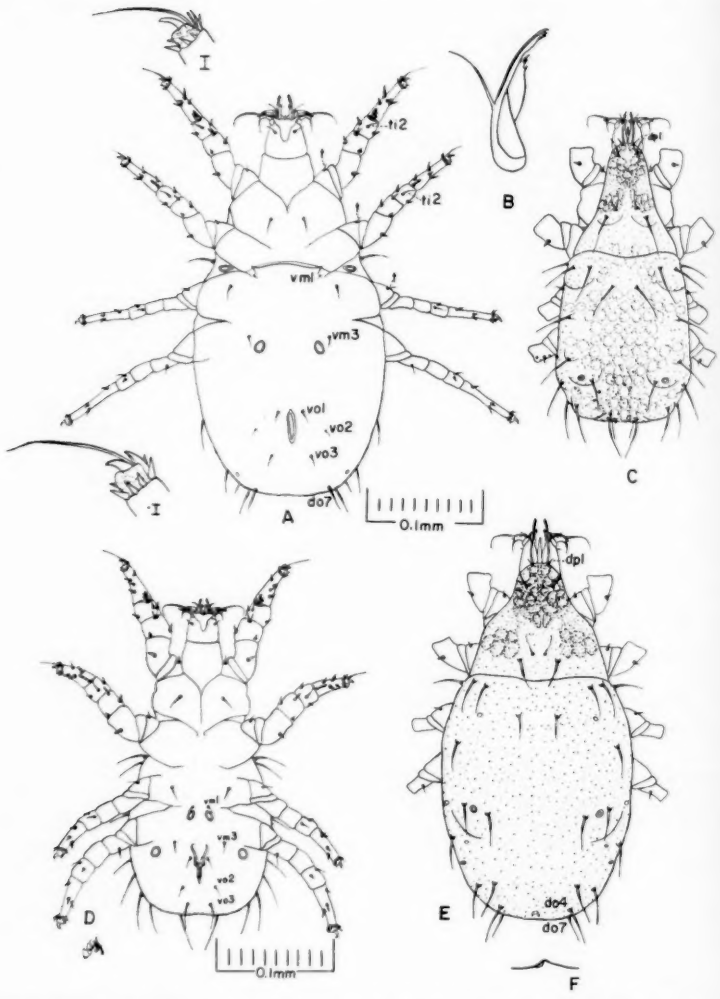

Plate 26 — *Histiostoma gordius*. A — female, venter. B — chelicera. C — male, dorsum. D — male, venter. E — female, dorsum. F — bursa copulatrix.

oval; *r2* widely separated, on level with external genitalia. Setae generally similar to *H. julorum* except: *vm3* anterio-mesiad of *r2; vo2* and *vo3* shorter. *Dorsum.* — Granular and heavily sculptured, especially on the rostrum, anterio-lateral region of the propodosoma, and mid-region of hysterosoma. Except for setae *dp1* which are shorter, the dorsal setae are generally the same as in *H. julorum*. Pit-like structures not observed, perhaps because of heavy sculpturing. Bosses conspicuous. *Legs.* — Except for typical male robustness, details of legs essentially similar to female.

Deutonymph. — (Plate 25). Length 0.140 mm.; width 0.106 mm. *Venter.* — Fused pedipalps equal to genu I; *pp1* longer than tarsus II. Apodemata *a2* and sternum *st1* nearly touching strongly united apodemata *a4;* sternum *st2* meets *a4; st3* and *st4* faintly continuous. *Dorsum.* — Hysterosoma pitted, especially near lateral margins; anterior margin transversely striated; propodosoma smooth except for a single line of transverse sculpturing. Propodosomal setae hairlike, about one-half length of typical hysterosomal setae; *do4* and *do6* short, hairlike; other hysterosomal setae longer than tarsus I, finely tapering and flexible. *Legs.* — Legs similar to *H. julorum*, except: generally smaller; femur I and genu I broader; seta *f* leg I longer; *f* leg II shorter; *f* leg IV shorter.

Remarks. — The combination of female characteristics most useful in identifying this species is: non-serrated chelicera, relative lengths of pedipalpal setae, position of *vm3*, position and size of *r1* and *r2*, granular dorsum, and the anterio-lateral sculpturing. In addition to the above, the male is distinctive for hysterosomal sculpturing. Deutonymph is distinctive because of the presence of eight pairs of long setae, pitted hysterosoma, and arrangement of apodemata. This species is arrhenotokous. Two "varieties" have been collected: "Florida" described above; "Virginia," differing from "Florida" by lack of sculpturing on anterio-lateral margin of hysterosoma in female, and in the male by having seta *vm1* laterad instead of anteriad of *r1*.

Collections. — "Florida variety": Collected by H. Wichmann on *Ips proximus* Eichhorn and *Ips laricis* Fabricus in Tirol, on the Thaya in Niederosterreich and Mokre in Bosnien, Feb. and May, 1914, and May, 1921; by R. D. Hughes in compost near Ellerson, Va., Oct., 1951 and in woods near Palmetto, Fla., Jan., 1954. "Virginia variety": Collected by R. D. Hughes in Chickahominy Swamp, Aug., 1954.

Types. — Holotype in Vitzthum's collection. Plesiotypes (supplied by present authors) as follows:

U. S. National Museum, Washington, D. C.

British Museum of Natural History, London, England

Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands

Museum National d'Histoire Naturelle, Paris, France
The South Australian Museum, Adelaide, South Australia
Natal Museum, Pietermaritzburg, Union of South Africa
National Collection, Ottawa, Canada.
USSR Academy of Science, Moscow and Leningrad, USSR
Musee Royal d'Histoire Naturelle de Belgique, Brussels, Belgium

Histiostoma himalayae (Vitzthum), 1923, new combination

(Plates 27, 28)

Anoetus himalayae Vitzthum, 1923.

Female. — (Plate 27). Length 0.360 mm.; width 0.230 mm. *Venter.* — Chelicera with three minute lobes distally and ending in a bristle; median process similar, but smaller; flagellum same length as *H. julorum.* Seta *pp1* half length of *pp2;* pedipalpal membranous structure extends beyond pedipalp. Ringlike structure *r2* oval or nearly round, lying anterio-laterad of anus. Setae generally shorter than in *H. julorum,* otherwise similar except *vm3* is anterio-laterad of *r2; vo1* longer; *vo2* extremely minute; *vo3* one-half length; *do7* ventral. *Dorsum.* — Smooth except for faintly granular rostrum. Setae generally similar in arrangement to *H. julorum,* but generally shorter. Bursa copulatrix is a raised tube-like structure. *Legs.* — Similar to *H. julorum,* except: seta *t* legs I-III minute; seta *f* leg IV shorter; *ti2* legs I-II longer.

Male. — (Plate 27). Length 0.300 mm.; width 0.160 mm. *Venter.* — Gnathosoma as in female. Ringlike structures nearly round; *r2* laterad of anus. Setae generally shorter than *H. julorum; vm3* anterio-mesiad of *r2. Dorsum.* — Smooth except for slightly granular rostrum. Setae generally shorter than *H. julorum. Legs.* — Setae size and pattern similar to female; legs slightly heavier.

Deutonymph. (Plate 28). Length 0.172 mm.; width 0.124 mm. *Venter.* — Fused pedipalps equal to genu I; seta *pp1* slightly longer than tarsus II. Base of gnathosoma from which fused pedipalps arise, bulbous and extending anteriorly. Sternum *st1* free; *a2* nearly touching *a4; a4* distinctly continuous in midline; *st2* faintly continuous with *a4;* discs *di1, di2,* and *di3* equal in size. *Dorsum.* — Smooth except faint transverse sculpturing on propodosoma and transverse striations on anterior margin of hysterosoma. Seta *dp4* equal to genu I, and one-half the length of *dp3; do4* and *do6* one-half length of *dp4;* other hysterosomal setae long, hairlike, and nearly equal to *dp3. Legs.* — Setae arrangement similar to *H. julorum* except: setae *f* legs I-II much longer; *f* leg IV shorter.

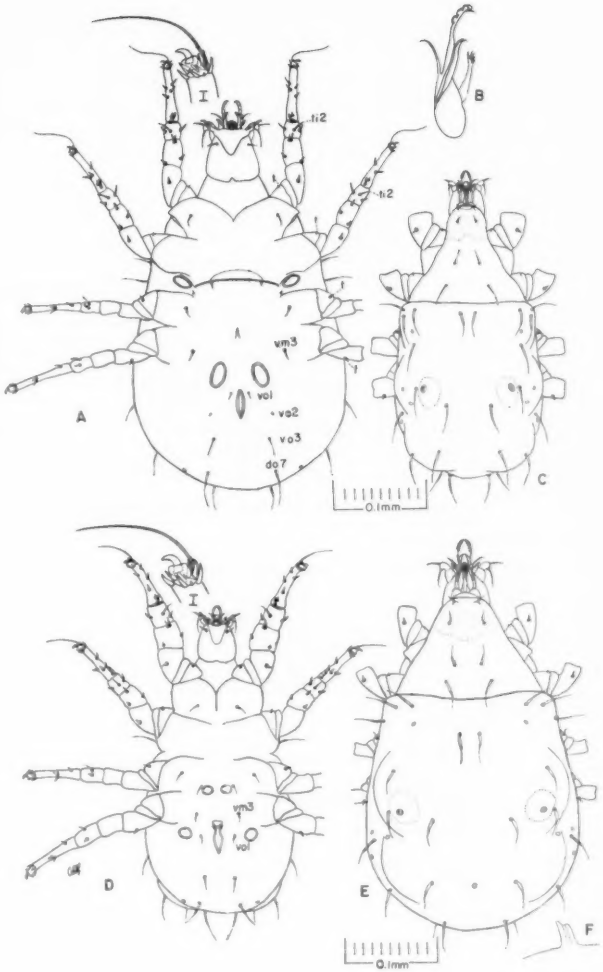

Plate 27 – *Histiostoma himalayae*. A – female, venter. B – chelicera. C – male, dorsum. D – male, venter. E – female, dorsum. F – bursa copulatrix.

Remarks. — The combination of characteristics most useful in identifying this species is: lobed chelicera; *pp2* longer than *pp1;* unusual position of *r2* in female; enlarged pedipalpal base and long hairlike setae on dorsum of deutonymph. This species is arrhenotokous. Our deutonymph appears to differ from Vitzthum's figure and description in the number of long, dorsal setae, size of coxal and suctorial plate discs, and the length of *ta3 l*eg I. Vitzthum states that the dorsal setae are easily overlooked and that it is difficult to determine the disc size.

Collections. — Collected by H. Wichmann on *Polygraphus minor* Stebbing, *Ipiden* collection from Bawar-Range, Jaunsar Makrata, Himalaya, Sept. 1912; by G. S. Foresman in woods, Bluefield, W. Va., June 1950; by R. D. Hughes in woods near Ellerson, Va., July 1950, Aug. 1950; by C. O. Goode in woods by lake, University of Richmond, Va., Oct. 1950; by R. D. Hughes in Smoky Mountains, Norris Dam, Tenn., July 1951; by E. C. Nelson in woods 5 miles east of Mechanicsville, Va., Sept. 1951; by R. D. Hughes in compost, near Ellerson, Va., Oct. 1951; by R. D. Hughes in Chickahominy Swamp, near Ellerson, Va., Oct. 1951; by Mr. Blood in orange grove, Lantana, Fla., Dec. 1951; by R. D. Jones in swamp, Woodlawn, Va., June 1952; by R. D. Hughes under plum trees, near Ellerson, Va., Aug. and Sept. 1952; by R. D. Hughes in Chickahominy Swamp, near Ellerson, Va., Aug. 1954.

Types. — Holotype in Vitzthum's collection. Plesiotypes (supplied by present authors) as follows:

U. S. National Museum, Washington, D. C.

British Museum of Natural History, London, England

Rijksumuseum van Natuurlijke Historie, Leiden, Netherlands

Museum National d'Histoire Naturelle, Paris, France

The South Australian Museum, Adelaide, South Australia

Natal Museum, Pietermaritzburg, Union of South Africa

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USSR Academy of Science, Moscow and Leningrad, USSR

Musee Royal d'Histoire Naturelle de Belgique, Brussels, Belgium

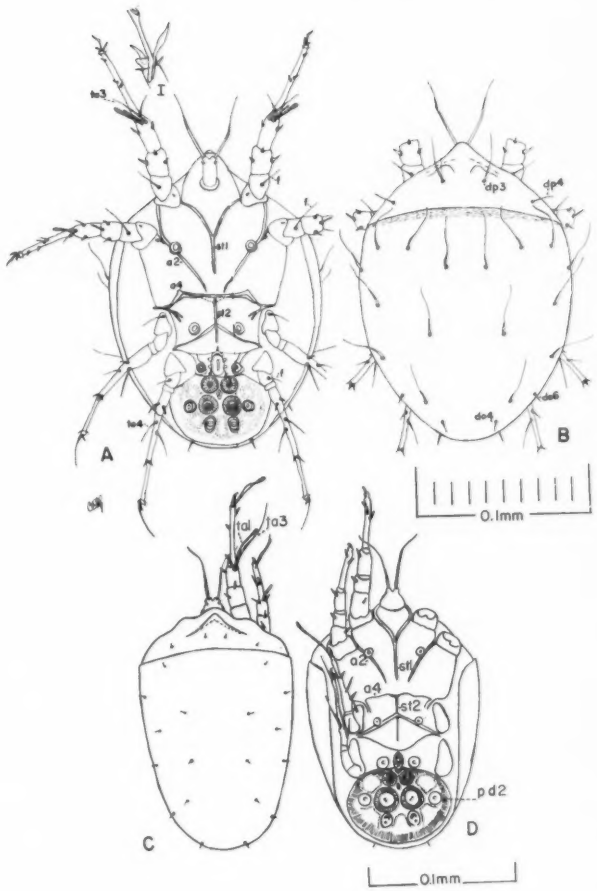

Plate 28 — Upper, *Histiostoma himalayae* deutonymph. A — venter. B — dorsum. Lower, *Histiostoma indicus* deutonymph. C — dorsum. D — venter. (Original unpublished drawing by A. C. Oudemans)

Histiostoma humiditatis (Vitzthum), 1927

(Plate 29)

Anoetus humiditatis Vitzthum, 1927; *Histiostoma humiditatis* (Vitzthum), 1927 [Womersley, 1942].

Female. — (Plate 29). Length 0.390 mm.; width 0.240 mm. *Venter.* — Chelicera very finely serrated, bearing approximately 20 equal teeth, and ending in a spinous process; median process toothed; flagellum twice the length of *H. julorum*. Seta *pp1* twice the length of tarsus I, 6 times as long as *pp2*, finely tapering, and flexible. Ringlike structure *r2* distinctly elongated. Setae generally shorter than *H. julorum*. Seta *vo3* equal to *vo2; vm3* median to *r2; do7* ventral. *Dorsum.* — Dorsum finely granular and sometimes with minute projections giving a fuzzy appearance; rostrum faintly sculptured. Setae generally smaller than *H. julorum; dp1* and *dp2* minute. Bursa copulatrix raised, heavily granular, opens anteriorly and on level with *do3*. *Legs.* — Similar to *H. julorum,* except: seta *ta2* leg I longer; setae *t* legs I-II shorter.

Male. — This species is thelytokous.

Deutonymph. — (Plate 29). Length 0.140 mm.; width 0.100 mm. *Venter.* — Fused pedipalps longer than tibia I; *pp1* nearly equal to tarsus II. Sternum *st1* free; apodemata *a2* continuous with *a4; a4* faint membranous portion connected in midline and joining *st2*. Discs *di1*, *di2*, and *di3* nearly equal. *Dorsum.* — Smooth except for single line of transverse sculpturing on propodosoma, and faint transverse striations on anterior margin of hysterosoma. Setae minute, hairlike, and equal. *Legs.* — Similar to *H. julorum* except: seta *ta3* leg I twice length.

Remarks. — The combination of female characteristics most useful in identifying this species is: finely serrated chelicera, long finely tapering *pp1*, elongated *r2*, and position of *vm3* mesiad of *r2*. Deutonymph difficult to distinguish from *H. bakeri* and *H. feroniarum*. What Womersley describes as the male of this species is, in reality, the tritonymph.

Collections. — Collected by H. Wichmann on *Agaricus melleus* in moist pine needles, Niederoesterreich, Thaya, Lower Austria, June 1923; by S. L. Allen on the roots of tomato plants grown in nutrient solution, Ryde, New South Wales, Sept. 1941; by R. D. Hughes in Chickahominy Swamp, near Ellerson, Va., Oct. 1951; by R. D. Hughes near Ellerson, Va., July 1952; by A. H. O'Bier north of River Road, 9 miles west of Richmond, Va., Oct. 1954; by R. D. Hughes near Ellerson, Va., Oct. 1955, Dec. 1955.

Types. — Holotype in Vitzthum's collection. Plesiotypes (supplied by

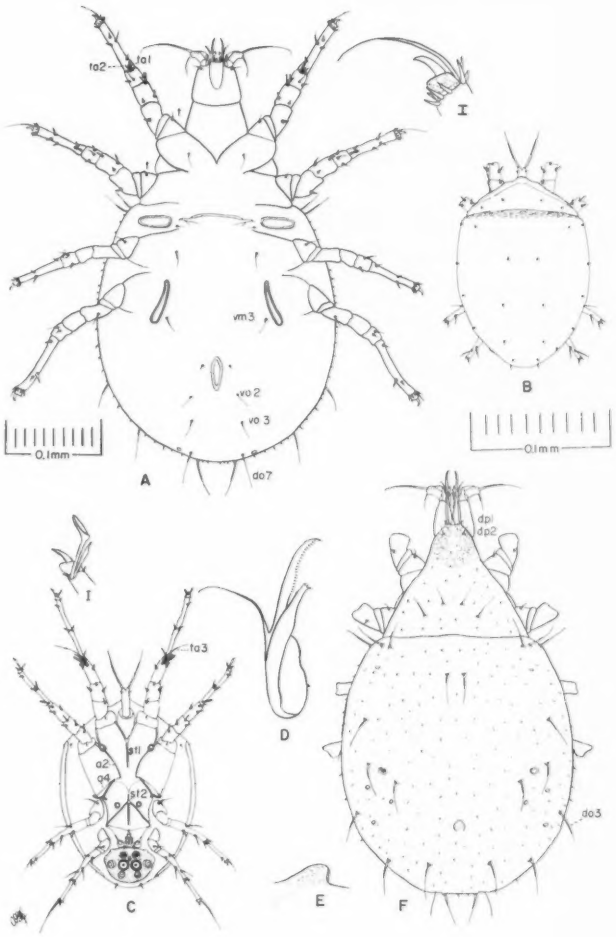

Plate 29 — *Histiostoma humiditatis*. A — female, venter. B — deutonymph, dorsum. C — deutonymph, venter. D — chelicera. E — bursa copulatrix. F — female, dorsum.

present authors) in U. S. National Museum, Washington, D. C. Plesiotypes in author's collection.

Histiostoma indicus (Oudemans), 1911

(Plate 28)

Anoetus indicus Oudemans, 1911; *Histiostoma indicus* (Oudemans), 1911 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 28). Length 0.160 mm.; width 0.110 mm. *Venter.* — Fused pedipalps equal to genu I, with broad base and tapering anteriorly; seta *ppl* equal to tarsus I. Sternum *st1* and apodeme *a2* free; *a4* continuous in midline and united with *st2*. Discs *di1* and *di2* smaller than *di3; di3* equal to disc *pd2*. *Dorsum.* — Smooth; propodosoma with pointed elevation; anterior margin of propodosoma undulating. Setae minute, hairlike, and equal. *Legs.* — Seta *ta16* legs I-III spatulate; *ta16* leg IV four times the length of the claw and tapering. Leg I seta *ta1* two-thirds length of tarsus I; *ta3* longer than tarsus I.

Remarks. — Outstanding features are the terminal tarsal setae legs I-III, the shape of the gnathosoma, and the long *ta1* and *ta3* leg I. One dorsal seta and a few leg setae are not shown in Oudemans' figures.

Collections. — One specimen on a blattid with hard abdomen, collected by D. MacGillavry in Banjoewangi, Java, 1910.

Types. — Holotype in Oudemans' collection.

Histiostoma insularis (Oudemans), 1914, new combination

(Plate 30)

Anoetus insularis Oudemans, 1914

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 30). Length 0.170 mm.; width 0.110 mm. *Venter.* — Fused pedipalps narrow, equal to genu I; seta *ppl* equal to tarsus II. Sterna *st1* and *st2*, and apodemata *a2* and *a4* end free in midline. Discs *di1* and *di2* slightly smaller than *di3*. *Dorsum.* — Smooth; setae minute, hairlike and equal. Shape elongated. *Legs.* — Seta *ta1* leg

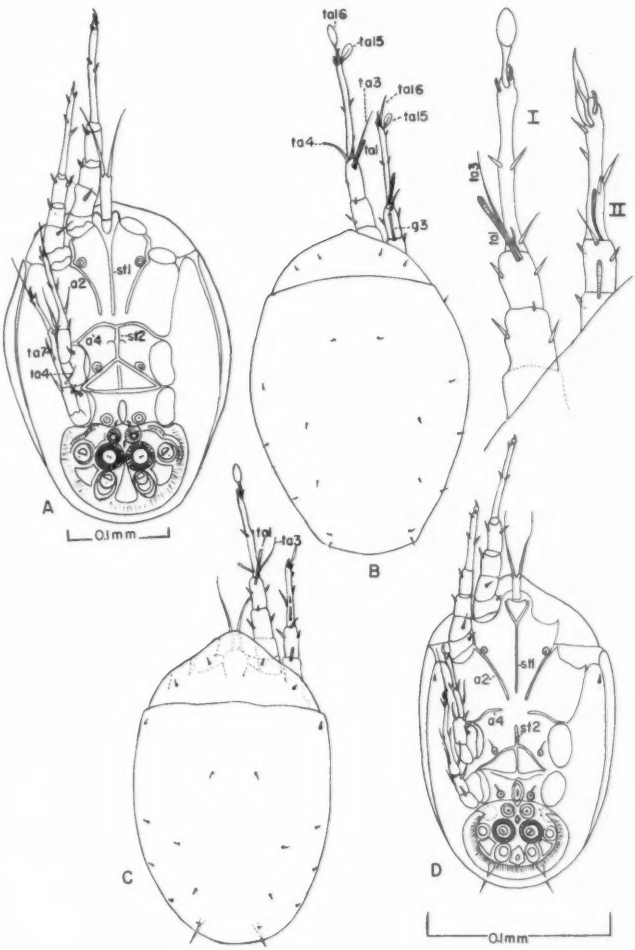

Plate 30 — Upper, *Histiostoma insularis* deutonymph. A — venter. B — dorsum. Right, legs I and II. (After Oudemans) Lower, *Histiostoma litoralis* deutonymph. C — dorsum. D — venter. (After Oudemans)

I one-half as long as tarsus II; *ta3* leg I over one-half length of tarsus I; other leg setae generally similar to *H. julorum*.

Remarks. — A few dorsal setae and leg setae are not shown in Oudemans' drawing. (See remarks under *H. feroniarum*) Absence of *ta16* leg III probably an oversight.

Collections. — Collected by D. MacGillavry on Terschelling Island, Netherlands, Aug., 1912.

Types. — No record.

Histiostoma lanceocrinus (Oudemans), 1914

(Plate 31)

Anoetus lanceocrinus Oudemans, 1914; *Histiostoma lanceocrinus* (Oudemans), 1914 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 31). Length 0.162 mm.; width 0.116 mm. *Venter.* — Fused pedipalps equal in length to genu I; pedipalpal setae *pp1* equal to tarsus II. Sterna *st1* and *st2* and apodemata *a2* unite with apodemata *a4* which are continuous in midline; *st2* continuous with *a5*; *st2* with rounded expansion and continuous with *st3*, coxal discs *di1*, *di2*, and *di3* nearly equal. Suctorial plate large; functional suckers *su* nearly as large as *pd1*. *Dorsum.* — Granular; hairlike setae, approximately equal to genu II except for *dm1*, *dm2*, and *do1* which are equal to *pp1*, and saber-shaped; *do4* minute. *Legs.* — Tarsi I-II shorter than *H. julorum*; *ta16* legs I-II spoon-shaped; seta *ta4* leg IV short; other characteristics generally the same as *H. julorum*.

Remarks. — Two dorsal setae and a few leg setae are not shown on Oudemans' drawing. Features most useful in identifying this species are length of pedipalps and *pp1*, arrangement of apodemata, large suctorial plate, granular dorsum, saber-shaped dorsal setae, spoon-shaped *ta16* legs I-II and length of *ta3* leg I.

Collections. — Collected by D. MacGillavry, Wijk aan Zee, Netherlands, July, 1911.

Types. — Holotype in Oudemans' collection.

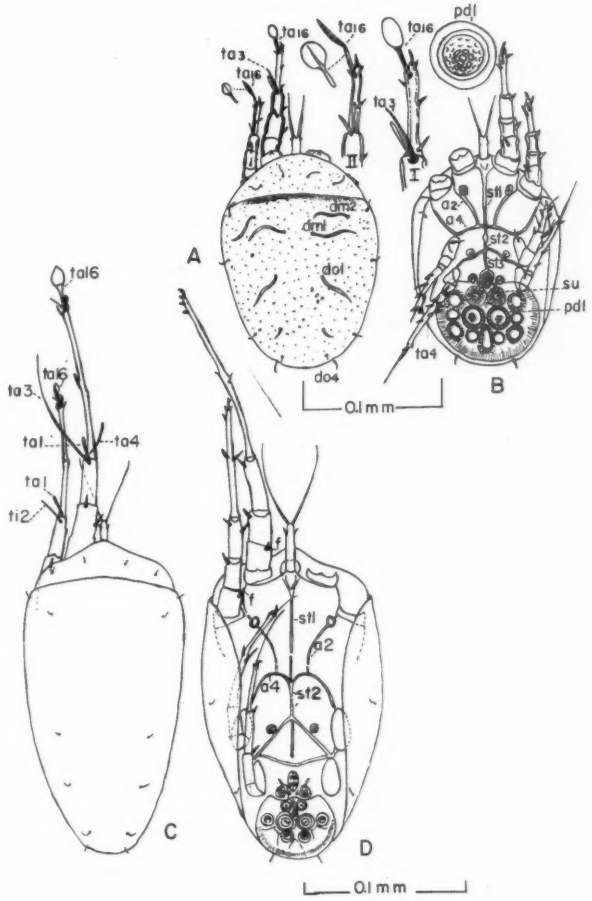

Plate 31 — Upper, *Histiostoma lanceocrinus* deutonymph. A — dorsum. B — venter. (Original unpublished drawings by A. C. Oudemans) Lower, *Histiostoma longipes* deutonymph. C — dorsum. D — venter. (Original unpublished drawing by Oudemans)

Histiostoma litoralis (Oudemans), 1914

(Plate 30)

Anoetus litoralis Oudemans, 1914; *Histiostoma litoralis* (Oudemans), 1914 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 30). Length 0.320 mm.; width 0.221 mm. *Venter.* — Fused pedipalps equal in length to tibia I; pedipalpal setae *ppl* approximately two-thirds the length of tarsus I. Sternum *st1* and apodemata *a2* end free; *a4* and *st2* unite in mid-line; fine hairlike extensions arise from *st2*. Discs *di1* and *di2* slightly smaller than *di3*. *Dorsum.* — Smooth; setae minute, hairlike, and equal. *Legs.* — Leg I tarsi I-II long, nearly equal; setae *ta15-16* spoon-shaped, one-half length of tarsus I; *ta4* slightly longer than *ta1*. Leg II seta *ta16* tapering, *ta15* spoon-shaped, *g3* equal to *ta1*, setae *ta4* and *ta7* leg IV shorter than *H. julorum*.

Remarks. — Assuming Oudemans' measurements to be correct, the deutonymph of this species is the largest in the family Anoetidae. Two dorsal setae and a few leg setae are not shown on Oudemans' drawing. Oudemans shows seta *g3* leg II as striated. This is probably incorrect. Features most useful in identifying this species are the length of pedipalps and *ppl*, arrangement of apodemata, smooth dorsum, minute dorsal setae, length of *ta2* leg I, spoon-shaped *ta15* legs I-II and spoon-shaped *ta16* leg I, tapering *ta16* leg II.

Collections. — Collected by D. MacGillavry, Tershelling Island. Aug., 1912.

Types. — Holotype in Oudemans' collection.

Histiostoma longipes (Oudemans), 1911

(Plate 31)

Anoetus longipes Oudemans, 1911; *Histiostoma longipes* (Oudemans), 1911 [Buitendijk, 1945]; *Anoetus brevipes* Oudemans, 1911.

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 31). Length 0.177 mm.; width 0.100 mm.

Venter. — Fused pedipalps narrow, equal to tibia I, pedipalpal base small; seta *pp1* nearly equal to genu I plus tibia I. Sternum *st1* and apodemata *a2* faintly connected to *a4;* apodemata *a4* distinctly arched and joined to *st2* in midline. Coxal discs *di1* on *a2* equal in size to *di2-di3. Dorsum.* — Smooth, setae minute, hairlike, and equal. Lateral margins of hysterosoma distinctly folded ventrally. *Legs.* — Tarsus I over twice as long as *pp1; ta16* spoon-shaped; *ta3* three-fourths length of tarsus I; *ta4* longer than *ta1; f* spine-like. Tarsus II two-thirds length of tarsus I; seta *ta16* lancet-shaped, *ti2* longer than *ta1*, f spine-like; legs III-IV similar to *H. julorum* except fewer long setae.

Remarks. — Features most useful in identifying this species are as follows: shape of fused pedipalps, length of *pp1,* arrangement of apodemata, smooth dorsum with short equal setae, extremely long tarsus I and elongated *ta3* leg I. Another variety of this species was collected from the same blattid which Oudemans calls the *brevipes* form of *A. longipes.* The two "varieties" are the same except *brevipes* has a shorter body, less foldings on the margin of the hysterosoma, larger propodosoma, shorter leg I, shorter seta *ta3* leg I, tapering *ta16* leg II. With the possible exception of the relative difference in size of leg I of the two specimens examined by Oudemans, it is doubtful that the differences noted above are of sufficient magnitude to justify the establishment of the variety *brevipes.* Individual differences of type and magnitude as those listed have often been observed in other species in which large numbers of specimens were available for study. The method of mounting the specimen may account for some of these differences. Oudemans suggests that the difference between the two specimens he studied are of different sexes. This is almost certainly not the case since careful studies of nymphal forms in other species with this point in mind have invariably shown that both primary and secondary characteristics do not become evident until the adult stage. A few dorsal and leg setae have been omitted in Oudemans' drawing.

Collections. — Collected by D. MacGillavry on a blattid with hard abdomen, Banjoewangi, Java, 1910.

Types. — Holotype in Oudemans' collection.

Histiostoma lorentzi (Oudemans), 1905

(Plate 32)

Anoetus lorentzi Oudemans, 1905; *Histiostoma lorentzi* (Oudemans), 1905 [Womersley, 1941.]

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 32). Length 0.200 mm.; width 0.145 mm. *Venter.* — Fused pedipalps wide at base and slightly longer than tibia I; pedipalpal setae *pp1* equal to tarsus II; pedipalpal base small. Sternum *st1* continuous with *a4; a2* nearly touching *a4;* apodemata *a4* join mesially to form a straight, bar-like structure; *st2* faintly continuous with *a4* and *a5*. *Dorsum.* — Anterior margin of propodosoma concave. Dorsum pitted; anterior margin of hysterosoma transversely striated. Setae variable in length; propodosomal setae equal and slightly longer than tibia II; *dm1* heavier and equal to *pp1; do1* nearly twice as long as propodosomal setae; *dm2* equal to propodosomal setae; all other dorsal setae hairlike and equal to or slightly shorter than tibia II. *Legs.* — Tarsus I nearly half length of soma, seta *ta16* elongated leaf-shaped, *ta2* and *ta3* nearly equal, one-half length of tarsus I, *ta4* tapering and longer than *ta1*, *g3* equal to *ta4;* leg II seta *ta16* tapering, *ti1* thorn-like, *ti2* hairlike; legs III-IV similar to *H. julorum* except shorter setae *ta16*.

Remarks. — Features useful in identifying this species are shape of fused pedipalps, length of *pp1*, arrangement of apodemata, pitted dorsum, shape of propodosoma, heavy band of transverse striations, two pairs of longer dorsal setae, exceptionally long tarsus I, *ta2* and *ta3* nearly equal, and *ta16* leg I leaf-shaped, *ta16* leg II tapering. A few leg setae are not shown in Oudemans' drawing.

Collections. — Fourteen specimens on a coccinellid in decaying leaves, Cyclope Mountains, New Guinea, April 13, 1903. Collected by Messrs. de Beaufort and Lorentz.

Types. — Holotype in Oudemans' collection.

Histiostoma maritimus (Oudemans), 1914

(Plate 32)

Anoetus maritimus Oudemans, 1914; *Histiostoma maritimus* (Oudemans), 1914 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 32). Length 0.175 mm.; width 0.118 mm. *Venter.* — Fused pedipalps slightly longer than tibia I; *pp1* equal to tarsus II. Sternum *st1* free; apodemata *a2* barely joining apodemata *a4*, latter united in midline; *st2* short and united with *a5; st3* and *st4* continuous. Coxal discs *di2* slightly smaller than *di1* and *di3*. *Dorsum.* —

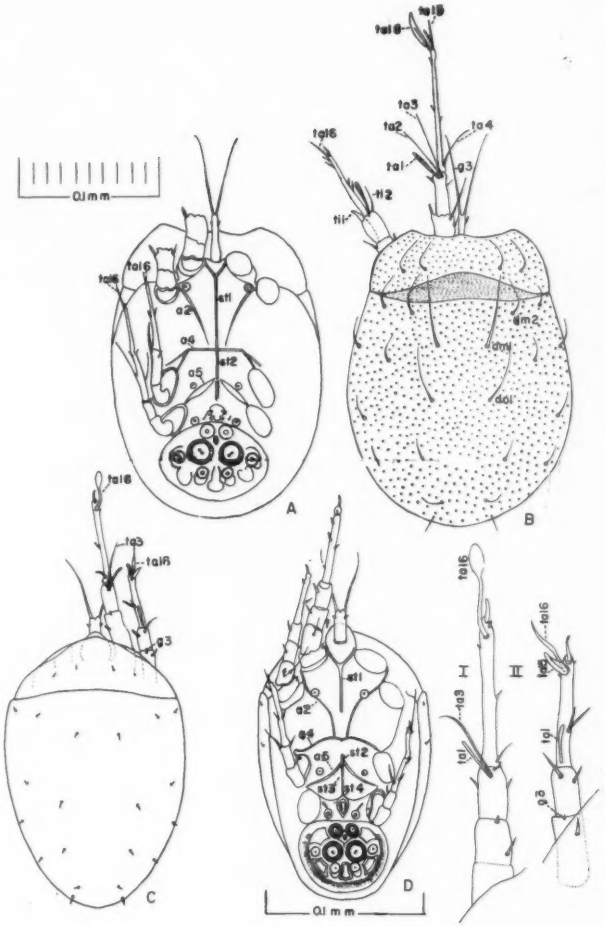

Plate 32 — Upper, *Histiostoma lorentzi* deutonymph. A — venter. B — dorsum. (After Oudemans) Lower, *Histiostoma maritimus* deutonymph. C — dorsum. D — venter. Right, legs I and II. (After Oudemans)

Smooth, setae minute, hairlike, and equal in length. Pedipalpal base projects slightly beyond the propodosoma. *Legs.* — Seta *tal6* leg I spoon-shaped, *ta3* one-half the length of tarsus I, femoral seta equal to genu I; leg II seta *tal6* lancet-shaped, *g3* very short, and seta *f* longer than in *H. julorum.*

Remarks. — The lancet-shaped seta *tal5* leg I was not observed by Oudemans and is either missing or is extremely small. A few leg setae are not shown on Oudemans' drawings. Features useful in identifying this species are: shape of fused pedipalps, length of *pp1,* arrangement of apodemata, size of coxal discs, smooth dorsum with minute setae, length of *ta2* leg I, *tal6* leg I spoon-shaped, and *tal6* leg II lancet-shaped.

Collections. — Collected by D. MacGillavry, Terschelling Island, August, 1912.

Types. — Holotype in Oudemans' collection.

Histiostoma murchiei, sp. nov.

(Plates 33-35)

Female. — (Plates 33, 34). Length 0.620 mm.; width 0.420 mm. *Venter.* — The entire gnathosoma of a gravid female is extremely small in comparison with the idiosoma and smaller than *H. julorum.* Chelicera smooth except for three minute terminal hook-like processes; cheliceral flagellum fine and equal in length to seta *dp1;* seta *pp1* minute, one-fourth length of tarsus I; *pp2* not observed, therefore missing or extremely minute. Ringlike structures small, circular; *r1* mesiad of *a5; r2* mesiad of *a6.* Ventral setae are fine, hairlike and variable in length; only *vo3* is as long as tibia I; seta *do7* is equal to *vo3* and is ventral instead of dorsal or marginal in position. The anus lies approximately in the center of the greatly enlarged opisthosoma. *Dorsum.* — Smooth; setae fine, hairlike; hysterosomal setae nearly equal to tibia I; propodosomal setae nearly equal, one-half length of tibia I. Opisthosoma greatly distended when gravid. Bursa copulatrix not raised, and nearly marginal in position. *Legs.* — The legs appear more fragile and have generally finer or smaller setae than in *H. julorum.* Legs III-IV are somewhat longer than in *H. julorum* with a terminal tarsal seta equal to claw. Leg II with supernumerary seta *ta-x.*

Male. — (Plate 35). Length 0.332 mm.; width 0.220 mm. *Venter.* — Gnathosoma small, almost vestigial and generally similar to female. Ringlike structures nearly circular and arranged in a square above the external genitalia. Setae hairlike and slightly variable in length, all approximately one-half the length of tibia I, except *vo1* which is slightly

shorter. Opisthosomatic region more elongated than *H. julorum*. *Dorsum*. – Smooth; setae fine, hairlike; hysterosomal setae approximately one-half

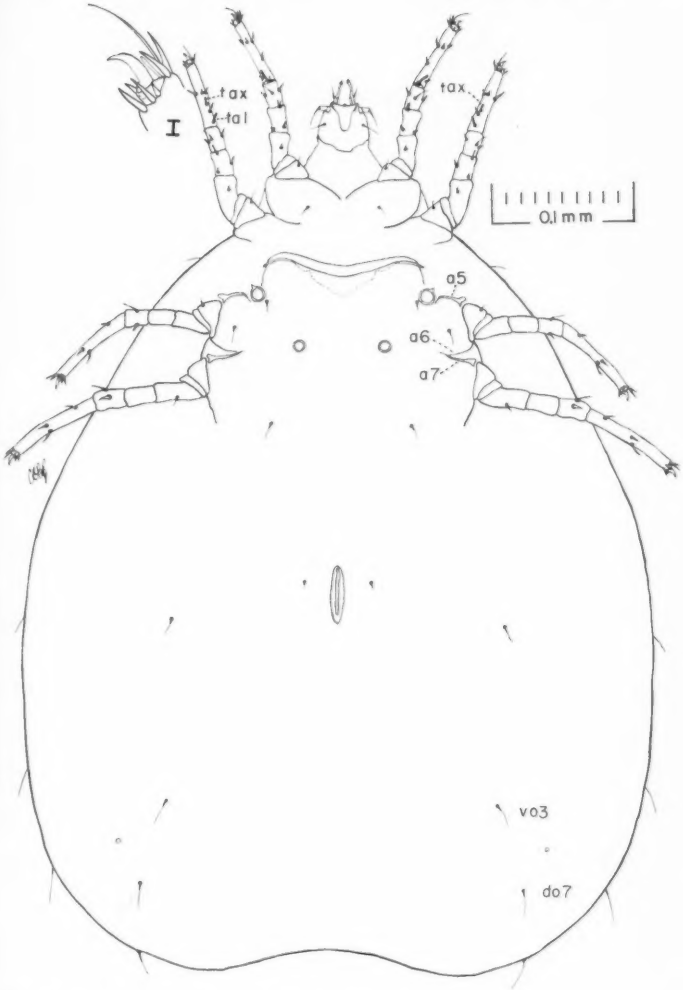

Plate 33 – *Histiostoma murchiei* sp. nov. female, venter.

length of tibia I; propodosomal setae shorter as in female. *Legs.* – All legs conspicuously long and slender, especially legs III-IV which are approximately equal to length of hysterosoma. Leg I setae generally similar to *H.*

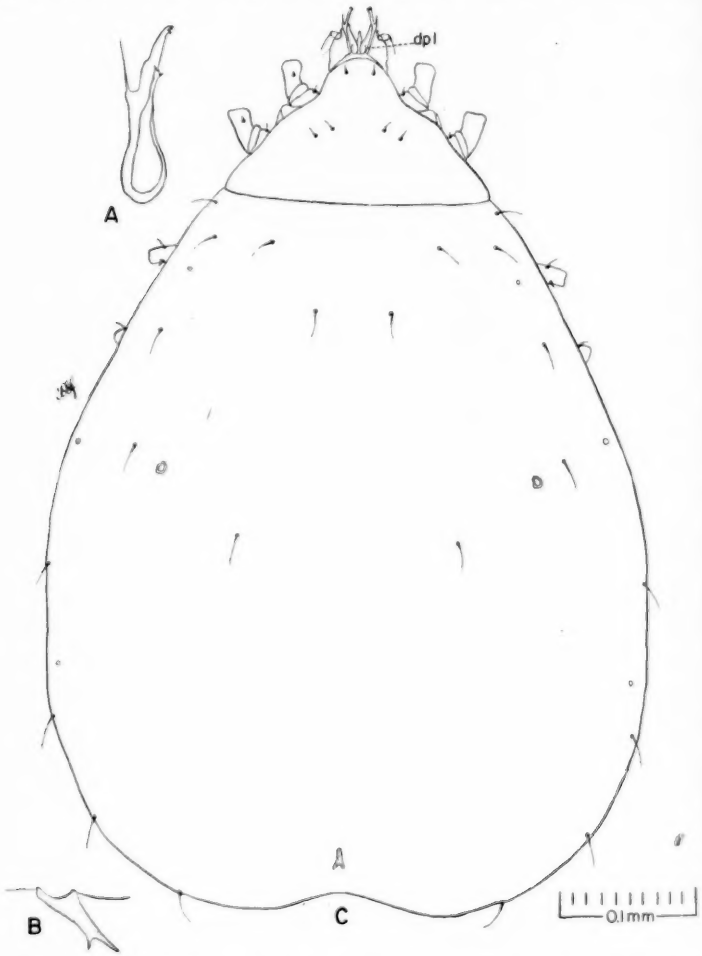

Plate 34 – *Histiostoma murchiei* sp. nov. A – chelicera. B – bursa copulatrix. C – female, dorsum.

julorum with the following exceptions; femoral seta smaller, *g1* smaller, *ti2* longer, *ta7* smaller, *ta15* not claw-like, *ta16* shorter. Leg II setae are generally similar to *H. julorum*, except smaller femoral seta, *ta6* and *ta7* smaller, and supernumerary sensory seta *ta-x* similar in size and shape to *ta1*; seta *ta8-ta9 legs* III-IV longer than claws. Claws on all legs extremely blunt.

Deutonymph. — (Plate 35). Length 0.192 mm.; width 0.140 mm. *Venter.* — Fused pedipalps almost vestigial, length and width equal; seta *pp1* equal to tibia I; *pp2* missing. Sternum *st1* free; apodeme *a2* faintly joined to apodemata *a4* which are continuous in midline; a membranous portion of *a4* faintly joins *st2*. Coxal discs *di1* and *di2* are unusually small; suctorial plate discs *pd2* and *pd3* are slightly larger than *di1*. Functional sucker *su* equal to *pd1*. *Dorsum.* — Dorsum smooth except for transverse sculpturing on the anterior margin of short propodosoma. Setae variable in length; setae *dm1*, *dm2*, *do1* and *do2* are equal to genu I; all other dorsal setae are shorter and nearly equal. *Legs.* — Setae *ta16* legs I-II lancet-shaped; *ta16* legs III-IV tapering, equal and twice length of claw. Leg setae are generally heavier than in *H. julorum*, other features as follows: femoral setae legs I-II more spine-like; leg I *ta1* longer and heavier, *ta3* twice as long, *ta4* twice as long with rounded tip; leg II *ti2* twice as long, *ta1* nearly twice as long and much heavier; *ti1* legs III-IV much heavier.

Remarks. — Features especially useful in identifying this species are: extremely small gnathosoma, missing pedipalpal seta *pp2*, greatly enlarged female opisthosoma, small circular ringlike structures *r1* and *r2*, extremely long legs of the male, blunt claws of the male, supernumerary tarsal II seta *ta-x*, nonserrated chelicera. For deutonymph, short fused pedipalps, propodosoma short, small *di1* and *di2*, and thorn-like leg setae. This species is of unusual interest because it is one of the only two species so far described which is semi-parasitic. The other species is *H. berghi* described above. Specimens were collected by W. R. Murchie in August 1954 in cocoons of *Allolobophora chlorotica* and possibly *Allolobophora caliginosa* and *Eisenia rosa*. These collections were made along the shore of the Carp River, Emmet County, Michigan (Township 38 north, Range 4 west, Section 15). In personal communications Dr. Murchie has furnished additional information as follows: the Carp River area where the largest collections were made, is forested and subject to spring floods. Infected cocoons have been collected in the same area for several years prior to 1954, with the percentage of infected cocoons remaining fairly constant throughout this period. Collections have also been made in Shiawassaa and Washtenaw counties. The inference is that this species probably has a wide distribution. Host relationships assume greater interest because *A. chlorotica* is presumed endemic to Europe. It is estimated that approximately 45% of *A. chlorotica* cocoons are infected. Over 50 of these co-

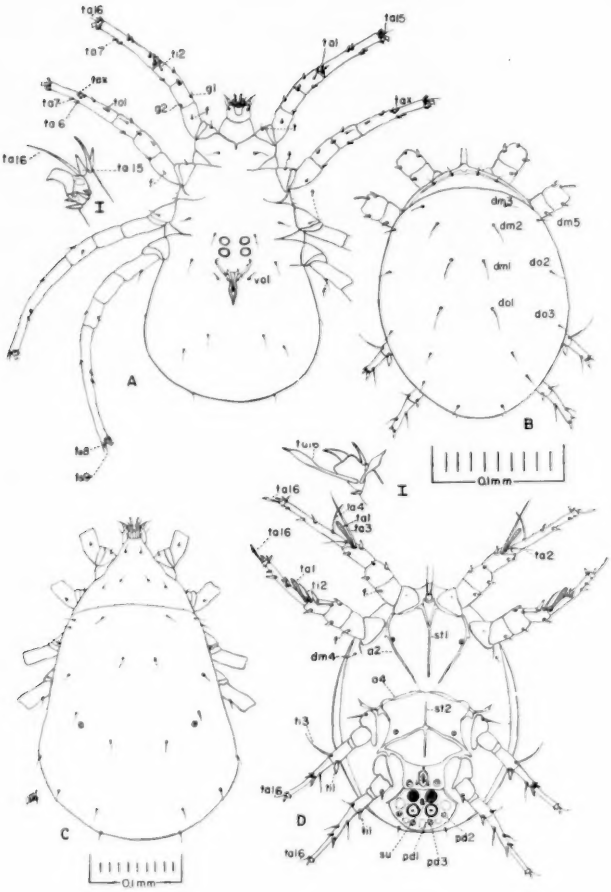

Plate 35 – *Histiostoma murchiei* sp. nov. A – male, venter. B – deutonymph, dorsum. C – male, dorsum. D – deutonymph, venter.

coons have been examined by us. In no instance was there an egg, embryo, or immature worm when mites were present. Presumably then, the mites feed on the eggs. Infected cocoons always contain a small number of adults and large numbers of other stages except tritonymphs. The tritonymph of *H. berghi* has atypically stout legs I-II. Jensen believes these stout legs are modified for boring into the cocoons of leeches, and reports an instance in which he thought this to be taking place. Whether or not this is the correct mode of infection by *H. berghi* is open to question since it is based on only one observation. No information is available on the mode of infection of cocoons by *H. murchiei*. Anoetids are generally unarmed surface feeders and it is doubtful that they could penetrate the tough cocoon of an annelid, even with stout legs. A possible mode of infection of cocoons by *H. murchiei* may be as follows: deutonymphs escape from broken or disintegrated cocoons and find their way to the anterior segments of an earthworm, where they become attached. When a cocoon is formed one or more deutonymphs become enclosed and metamorphose into a tritonymph and thence into an adult. Eggs develop to the deutonymph stage in the cocoon but not beyond. That this sequence of events is a probability is supported by the fact that usually only two or three adults are found per cocoon, that no tritonymphs have been found, and that the deutonymph is the typical migratory stage. Attempts to culture this species on stable fly media, which has been found to be suitable culture medium for a large number of other species, have so far failed. *H. berghi* and *H. murchiei* have a number of features in common aside from the fact that they are found in the cocoons of annelids. The females of both species are the largest anoetids so far described, pedipalpal seta *pp2* is missing, gnathosoma is almost vestigial, bursa copulatrix is marginal in position, and arrangement of ringlike discs in males is similar. These features indicate a close relationship. *H. murchiei* is the only anoetid species in which a supernumerary mid-tarsal II seta, designated *ta-x*, has been found. This occurs in both the male and female. It is not known whether this seta is found in *H. berghi* since Jensen omitted a number of typical leg setae from his drawings. This species is named in honor of W. R. Murchie.

Collections. — (See under remarks.)

Types. — Holotype female, and paratypes in U. S. National Museum, Washington, D. C. Paratypes in authors' collection.

Histiostoma necrophori (Dujardin), 1849

(Plate 36)

Hypopus necrophori Dujardin, 1849b; *Anoetus necrophori* (Dujardin), 1849 [Oudemans, 1924c]; *Anoetus neglectus* Oudemans, 1903 [Oude-

mans, 1924c]; *Histiostoma necrophori* (Dujardin), 1849 [Oudemans, 1937].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 36). Length 0.290 mm.; width 0.200 mm. *Venter.* — Fused pedipalps wide at base, equal to genu II; pedipalpal seta *pp1* equal to tarsus II. Sternum *st1* free but close to apodemata *a4*; apodeme *a2* joins with united apodemata *a4;* sternum *st2* is connected to *a4* and *a5*. Functional suckers *su* equal to plate discs *pd1*. Coxal discs *di1* and *di2* large and equal. *Dorsum.* — Dorsum smooth; propodosoma short, and nearly rectangular; setae equal, one-half length of *pp1*. *Legs.* — Seta *ta16* legs I-II spoon-shaped; leg III with spatulate terminal tarsal seta; terminal tarsal seta leg IV longer than the entire leg IV and tapering. Seta *ta3* leg I equal to tarsus II; *ti2* leg II nearly equal to *ta3* leg I; legs III-IV setae generally large.

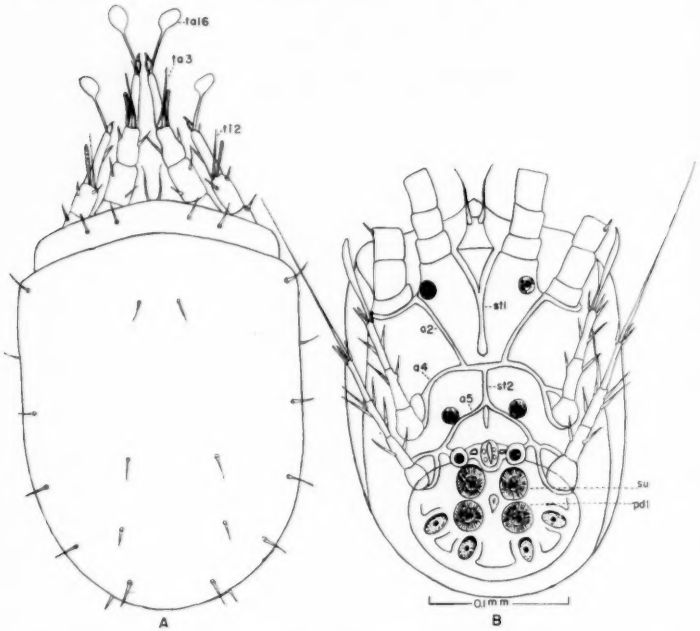

Plate 36 — *Histiostoma necrophori* deutonymph. A — dorsum. B — venter. (After Dujardin)

Remarks. — Characteristic features of this species which have diagnostic value are as follows: shape of fused pedipalps, length of *pp1*, short propodosoma, spoon-shaped *ta16* legs I-II, and unusual terminal tarsal setae legs III-IV, which may be modified claws as suggested for the fourth leg of *A. laboratorium*. Oudemans' figure of *A. neglectus* has been used.

Collections. — Collected by C. Dujardin on the beetle *Necrophorus vespillo*, 1849; by S. A. Poppe on the beetle *Necrophorus humator*, Bremen, Germany, 1902; by Frank A. Turk on *Necrophorus humator* along with a gasmid mite, Great Britain, Feb. 1943.

Types. — No record.

Histiostoma nigrellii sp. nov.

(Plate 37)

Female. — (Plate 37). Length 0.365 mm.; width 0.210 mm. *Venter.* — Chelicera finely serrated with approximately 14 teeth; cheliceral flagellum shorter than toothed portion. Seta *pp1* three times the length of *pp2*. Posterior ringlike structures *r2* elongated. Setae generally shorter than *H. julorum*. Seta *vo1* is equal to *vo2;* seta *vm3* posterio-mesiad of *r2; do7* ventral. *Dorsum.* — Dorsum finely granular and sometimes with minute projections giving a fuzzy appearance; rostrum faintly sculptured. Setae generally shorter than *H. julorum* except for *dp2*. Seta *dp3* distinctly shorter than *dp4*. Bursa copulatrix raised, opens anteriorly and is slightly above a line connecting setae *do5*. *Legs.* — Leg shape and setae size similar to *H. julorum* except *g3, g4, ta2* and *ti2* leg I longer; leg II seta *ti2* longer; legs III-IV setae *ti1* shorter, seta *ta9* longer than claw.

Male. — (Plate 37). Length 0.225 mm.; width 0.120 mm. *Venter.* — Gnathosoma as in female. Anterior ringlike structures *r1* elongated, lying close together above the external genitalia; posterior ringlike structures *r2* slightly elongated, and laterad of anus. Setae variable in length. Position of setae similar to *H.* julorum except: *vm3* anteriad of *r2; vo2* and *vo3* shorter than *H. julorum*. *Dorsum.* — Dorsum granular, sometimes with fine projections giving fuzzy appearance; rostrum faintly sculptured. Setae generally shorter than *H. julorum* especially *dp1*. Excretory pores distinctly elevated. *Legs.* — Shape and setae arrangement similar to *H. julorum* except: leg I midtarsal setae widely separated, *ta2* and *ti2* longer; leg II *ti2* longer. Claws somewhat heavier than in female, otherwise similar.

Deutonymph. — Not observed.

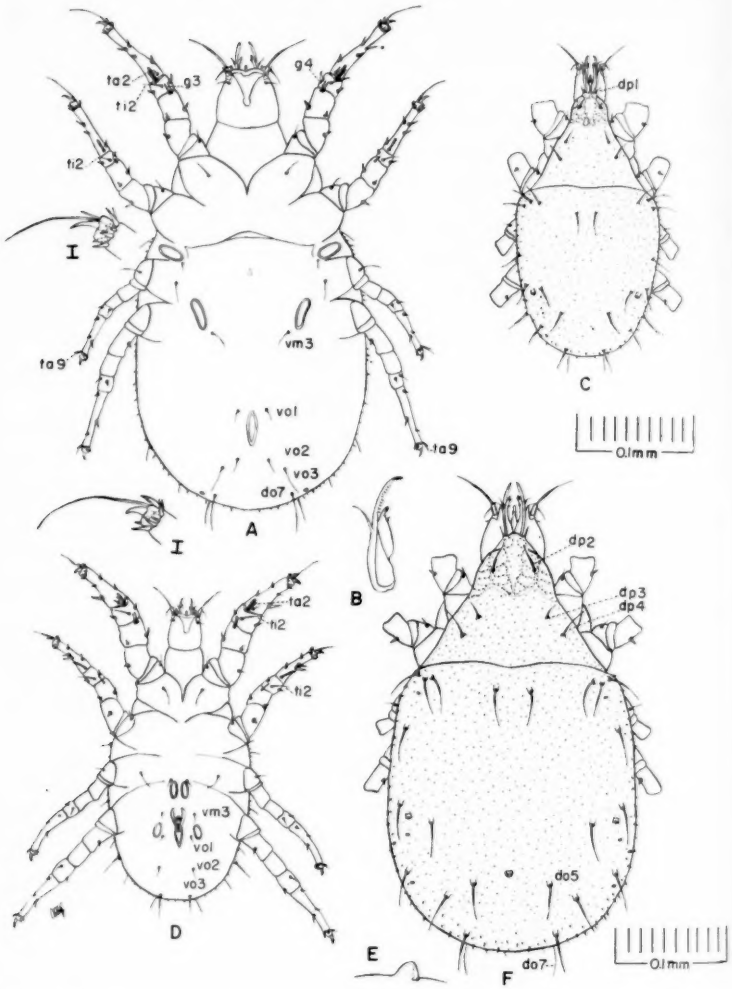

Plate 37 – *Histiostoma nigrellii* sp. nov. A – female, venter. B – chelicera. C – male, dorsum. D – male, venter. E – bursa copulatrix. F – female, dorsum.

Remarks. — See remarks on *H. cyrtandrae* above. Only the male and female of this species have been observed. No attempts to culture this species on housefly media were made and the colony was subsequently lost. It is tentatively placed in the genus *Histiostoma* on the basis of the general appearance of the adults. This species is of special interest because it is one of the only two species which has been observed to live completely submerged indefinitely. In this instance it was observed daily over a period of two weeks in water from an aquarium. The combination of adult characteristics most useful in identifying this species is: the finely serrated chelicera, *pp1* of medium length, granular dorsum, claws longer and less curved. For the female: shape of posterior ringlike structures and position of seta *vm3*, arrangement of anal and opisthosomatic setae, position of bursa copulatrix. For the male: position of posterior ringlike structures and setae *vm3* and *vo1*. Named in honor of Ross F. Nigrelli.

Collections. — Collected by Ross F. Nigrelli in a goldfish tank at the Aquarium, New York Zoological Society, March 1953.

Types. — Holotype and paratypes in authors' collection.

Histiostoma phyllophorus (Oudemans), 1905

(Plates 38, 39)

Anoetus phyllophorus Oudemans, 1905; *Histiostoma nichollsi* Womersley, 1941; *Histiostoma phyllophorus* (Oudemans), 1905 [Buitendijk, 1945].

Female. — (Plate 38). Length 0.360 mm.; width 0.215 mm. *Venter.* — Chelicera non-serrated, cheliceral flagellum longer than seta *dp4;* pedipalpal seta *pp1* finely tapering, longer than longest dorsal setae; *pp2* equal to *dp2*. Setae similar to *H. julorum*, except *vm1* shorter; *do7* ventral in position. Posterior ringlike structures elongated and lie on a line with coxa IV. *Dorsum.* — Dorsum sometimes with tiny projections giving a fuzzy appearance; rostrum granular, and faintly sculptured. Setae generally longer than in *H. julorum*. Bursa copulatrix nearly on a line with setae *do1* opening anteriorly on a slight elevation, and with a distinct elevation anterior to the opening. *Legs.* — Setae generally larger than in *H. julorum*, especially *ta1*, *ta2*, *g3* and *g4* of leg I; *ta1* and *g3* of leg II; and *ta5* and *ta7* of legs III-IV. Other differences are: generally longer and heavier terminal tarsal setae surrounding the claw on all legs, longer *ta9* legs III-IV, and especially the unique barb on the end of setae *ta5* legs III-IV.

Male. — (Plate 38). Length 0.270 mm.; width 0.120 mm. *Venter.* — Gnathosoma as in female. Posterior ringlike structures slightly elongated,

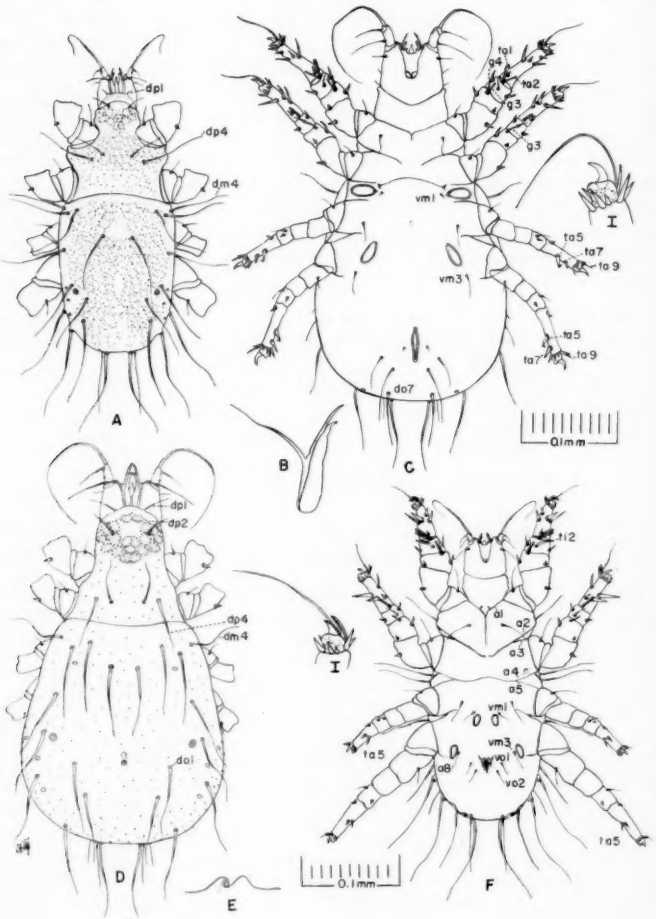

Plate 38 — *Histiostoma phyllophorus*. A — male, dorsum. B — chelicera. C — female, venter. D — female, dorsum. E — bursa copulatrix. F — male, venter.

widely separated and on a line between the genitalia and apodemata *a8*. Setae generally longer than *H. julorum*, except *vo2*. Setae arrangement generally similar except: *vm3* mesiad of *r2*, *vo2* closer to *vo1* and lateral to the posterior end of the anus. The sternum formed by the union of *a1* extends posteriorly close to the united *a2* and *a3* which almost meet in midline; apodemata formed by the union of *a4* and *a5* unite in midline. Anus shortened and nearly obscured by external genitalia. *Dorsum*. – Dorsum differs from female as follows: entire dorsum distinctly sculptured; setae generally finer; *dp1* shorter; *dp4* longer, *dm4* longer, opisthosomatic setae generally longer; pit-like structure *dpi1* not observed. *Legs*. – Setae similar to female except: *ti2* larger and midtarsal setae more massive on leg I; midtarsal seta larger on leg II; setae *ta5* leg III-IV without barb.

Deutonymph. – (Plate 39). Length 0.200 mm.; width 0.135 mm. *Venter*. – Fused pedipalps over one-half the length of tarsus I; seta *pp1* longer than tarsus I. Sternum *st1* unites with apodemata *a4* which join in midline; apodeme *a2* free posteriorly; lateral margin of apodeme *a2* forms heavily sclerotized processes at base trochanters I-II; *st2* joins *a4* and united *a5*; *st3* not quite touching *st4*. Disc *di1* lies on *a2*, equal in size to *di2* and smaller than *di3*. Suctorial plate with crenulated margins. Plate discs *pd1* larger than *H. julorum*. *Dorsum*. – Smooth except for a wide band of faint transverse striations at the anterior margin of the hysterosoma. Propodosoma with a thin, transparent membrane extending anteriorly, apparently from beneath. All setae long, fine, and flexible; *dm1*, *dm2*, *do1*, and *do5* over one-half the length of the hysterosoma, others slightly variable in length. *Legs*. – Legs I-II shorter than *H. julorum* especially the tarsi; seta *ta16* leg I lancet-shaped with distal end finely tapered; *ta16* leg II lancet-shaped; other leg setae generally larger than *H. julorum*, except femoral setae legs I-II. Seta *ta3* leg I nearly equal length of tarsus II.

Remarks. – Only the deutonymph was described by Oudemans and Womersley. Outstanding features are: unusual membranous anterior extension, arrangement of apodemata, large central discs on the suctorial plate, the wide band of transverse striations on the anterior hysterosoma, and the long fine dorsal setae. Although the dorsal setae are flexible they are easily broken and sometimes appear as stubs, or may be entirely missing. The combination of adult characteristics most useful in identifying this species is for the female: non-serrated chelicerae, long pedipalpal seta *pp1*, shape of *r2*, position of *vm3* with respect to *r2*, long dorsal setae, the position and structure of the bursa copulatrix, generally heavy leg setae and especially the unique barbed setae *ta5* of legs III-IV. For the male: gnathosoma as in female, arrangement of ventral setae, heavy leg setae legs I-II, dorsal sculpturing, and long fine dorsal setae.

Collections. – Collected by Prof. Ritzema Bos on *Oniscus asellus*

L., Leiden, South Holland, Netherlands, 1902; by K. J. W. Kempers on *Oxythyrea funesta,* Meerssen Limburg, Netherlands, 1903; on passalid, Amani, Dutch East Africa, 1911; on a small beetle, Crawley, Western Australia, Sept. 1940; by R. D. Hughes near compost pile, near Ellerson, Va., fall 1954; in duck pen near Ellerson, Va., Aug., 1955, and in damp woods, near Ellerson, Va., Oct. 1955.

Types. — Holotype in Natural History Museum in Hamburg. Plesiotypes (supplied by present authors) in U. S. National Museum, Washington, D. C. Plesiotypes in authors' collection.

Histiostoma piloseta sp. nov.

(Plates 39, 40)

Female. — (Plate 40). Length 0.350 mm.; width 0.220 mm. *Venter.* — Granular on gnathosomal base and on coxae at base of trochanters. Chelicera non-serrated, but bearing two "raking" processes; cheliceral flagellum nearly equal to *pp1,* but finer; pedipalpal seta *pp1* approximately equal to *dp2; pp2* short and fine. Ringlike structures extremely small, approximately one-third size of, but comparable in position to *H. julorum.* Setae generally somewhat shorter than *H. julorum,* all nearly equal, except *pp3* which is one-third length *vm1.* Seta *vm1* more mesiad in position than in *H. julorum.* Seta *do7* is ventral in position. *Dorsum.* — Rostrum granular and faintly sculptured; hysterosoma distinctly granular. Seta *dp1* similar to *H. julorum; dp2* slightly longer; all other dorsal setae slightly variable in size and distinctly pilose, except *do7.* Except for *dp1* all dorsal setae are borne on distinctly raised bosses. Setae *dp3, dp4, do1,* and excretory pore are borne on single bosses. The bursa copulatrix is elevated with a posterior opening, is heavily granular and lies on a line connecting setae *do1.* The pit-like structure *dpi3* not observed. *Legs.* — Legs longer and heavier in comparison with body size than *H. julorum;* leg setae generally larger, especially *ta1, ta2, ti2, g3,* and *g4* of leg I; *ta1, ti2* and *g3* of leg II; *ti1* and *ta4* of legs III-IV. Seta *t* of legs I-III, and *f* of leg IV shorter than in *H. julorum;* claws generally heavier.

Male. — (Plate 40). Length 0.215 mm.; width 0.120 mm. *Venter.* — Venter faintly granular. Gnathosoma as in female. Sternum extended more posteriorly and combined apodemata *a4-a5* extended more mesially than in *H. julorum.* Ringlike structures small, one-third size of *H. julorum; r2* round or ellipsoid, lateral to the external genitalia, and contiguous with *a8.* Distinct genital and anal plate. Setae variable in length. In comparison with setae of *H. julorum* seta *vp1* shorter and closer to midline; *vm1* longer and anterio-mesiad of *r1; vm3* longer, anterio-mesiad of *r2; vo1* longer, borne on the anal plate, opposite the mid-region of

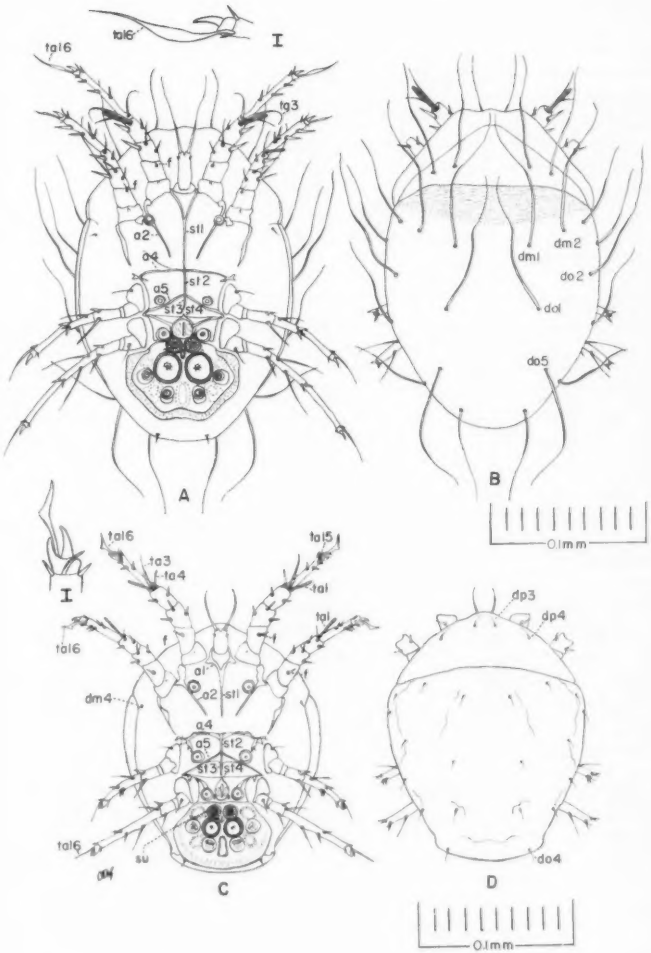

Plate 39 — Upper, *Histiostoma phyllophorus* deutonymph. A — venter. B — dorsum. Lower, *Histiostoma piloseta* deutonymph. C — venter. D — dorsum.

the anus; *vo2* shorter, borne on posterior margin of anal plate; *vo3* less than one-half as long. Penial seta directed anteriorly. *Dorsum.* — Dorsum faintly granular; rostrum and propodosoma more heavily granular than hysterosoma. Setae hairlike, somewhat variable in length; metapodosomal setae equal to *dp3;* opisthosomal setae slightly longer except *do2* equal metapodosomal setae; *do1* longest of dorsal setae; only the pit-like structure *dpi2* was observed. Unlike the female, the male is without bosses, except one bearing *dp2*. *Legs.* — Legs more slender than *H. julorum;* tarsus 1 longer; setae similar except: leg I, mid-tarsal setae more widely spread and generally smaller, *ta1* and *ta2* slightly larger, *ti2* three times as long, *g3* and *g4* longer, *g1* larger; leg II *ta6* and *ta7* smaller, *ta1* nearly four times as long, *ti2* and *ti3* longer; setae *t* legs I-III, and *f* leg IV shorter. Claws as in the female.

Deutonymph. — (Plate 39). Length 0.160 mm.; width 0.127 mm. *Venter.* — Fused pedipalps equal tibia I; pedipalpal seta *pp1* twice length of fused pedipalps. Apodemata *a1* with lateral sclerotized processes contiguous with trochanters I; *st1* free; apodeme *a2* heavily sclerotized forming a "T"-shaped structure anteriorly which is contiguous with trochanters I-II, posterior end free; *a4* distinctly raised, undulating, and continuous in midline with *st2;* *a5* continuous in midline with *st2* and *st3;* posteriorly *st3* does not quite meet *st4*. Discs *di1*, *di2*, and *di3* equal and distinctly larger than in *H. julorum*, and somewhat smaller than *su;* suctorial plate nearly hexagonal. The posterior end of opisthosoma is broad and ventrally turned. *Dorsum.* — Smooth, except hysterosoma irregularly and inconstantly crenulated. Setae medium in length, slightly variable, and hairlike; *dp3* and *dp4* equal and near anterior margin of propodosoma; hysterosomal setae variable and slightly shorter than *dp3*, except for the sub-marginal *do4*. *Legs.* — All legs shorter than in *H. julorum* due primarily to shorter tarsi. In comparison with *H. julorum* the following setae differences are noted: *f* legs I-II heavier and blunter, *ta1* and *ta3* longer, *ta16* larger spoon-shaped; leg II *ta1* longer, *ta16* spoon-shaped; legs III-IV most setae slightly larger, *ta16* slightly shorter. Claw base of all legs is slightly tapering.

Remarks. — The body shape, leg shape, and gnathosomal structure of the male and female are very similar. Marked sexual dimorphism exists with respect to presence or lack of pilose dorsal setae, dorsal bosses, granulation, and rostral sculpturing. The combination of adult characteristics most useful in identifying this species is as follows: non-serrated chelicera, pedipalpal seta of medium length, and small ringlike structures. In the female the usual pilose dorsal setae borne on bosses, heavily granular hysterosoma, and the position of the bursa copulatrix nearly in the center of the hysterosoma are distinctive. In the male the faintly granular dorsum and venter; relatively short hairlike dorsal setae, presence of anal and genital plate, position of *vm1* and *vm3*, and the ex-

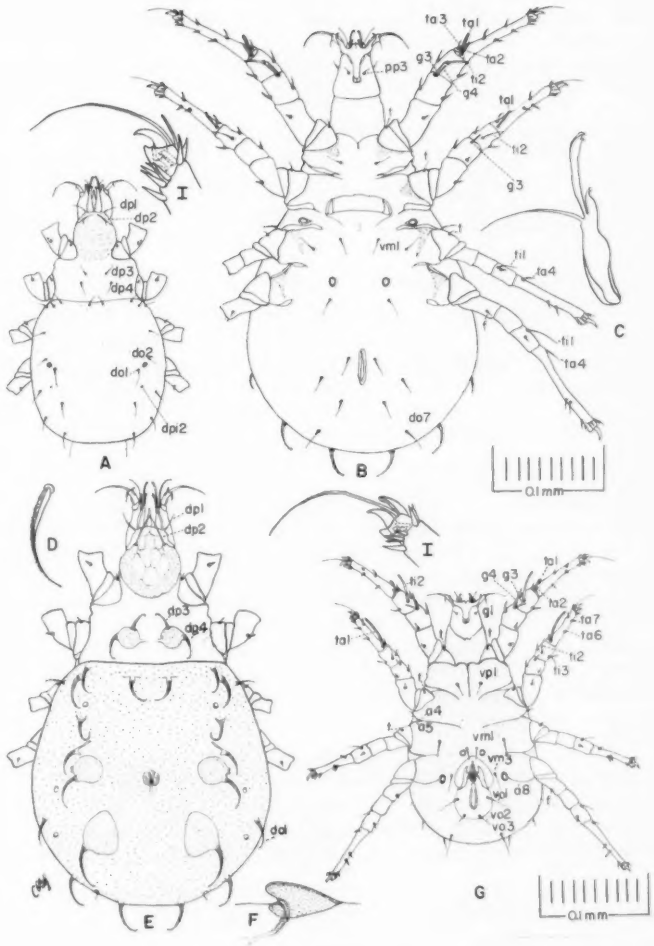

Plate 40 – *Histiostoma piloseta*. A – male, dorsum. B – female, venter. C – chelicera. D – dorsal pilose seta. E – female, dorsum. F – bursa copulatrix. G – male, venter.

ceptionally long seta *ti2* leg I and *ta1* leg II are outstanding features. Characteristics useful in identifying the deutonymph are: entirely smooth dorsum, except for inconstantly crenulated hysterosoma, fused pedipalps and pedipalpal setae of medium length, heavy apodemata, large coxal I, III, and IV discs, relatively short legs, and the unusual tapering claw base.

Collections. — Collected by R. D. Hughes from compost near Ellerson, Va., Nov. 1954.

Types. — Holotype and paratypes in U. S. National Museum, Washington, D. C. Paratypes in authors' collection.

Histiostoma polaki (Oudemans), 1914

(Plate 41)

Anoetus polaki Oudemans, 1914; *Histiostoma polaki* (Oudemans), 1914 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 41). Length 0.153 mm.; width 0.111 mm. *Venter.* — Fused pedipalps equal to tibia I; pedipalpal seta *pp1* nearly equal to tarsus II. Apodemata *a1* short; sternum *st1* and apodeme *a2* continuous with *a4* which latter meet in midline; *st2* connected to *a4* and *a5* with faint rounded expansion in mid-region *st3* free posteriorly. Coxal discs *di1* lie on *a2* and are equal to *di2* and *di3*. *Dorsum.* — Smooth except for faint transverse striations on anterior margin of hysterosoma; setae minute, hairlike, and equal. Membranous expansions extend from anterio-lateral margins of propodosoma. *Legs.* — Leg shape, setae size and setae arrangement similar to *H. julorum*.

Remarks. — The granular appearance of the dorsum is due to the fact that Oudemans' drawing was tinted. The features most useful in identifying this species are the arrangement of the apodemata as described above and the rounded expansion of *st2*. The complete complement of dorsal and leg setae are not shown in Oudemans' drawings.

Collections. — Twenty specimens on *Spriostreptus sp.* (Myriapoda), Dutch East Africa, collected by R. Polak, June 1912.

Types. — Holotype in Oudemans' collection.

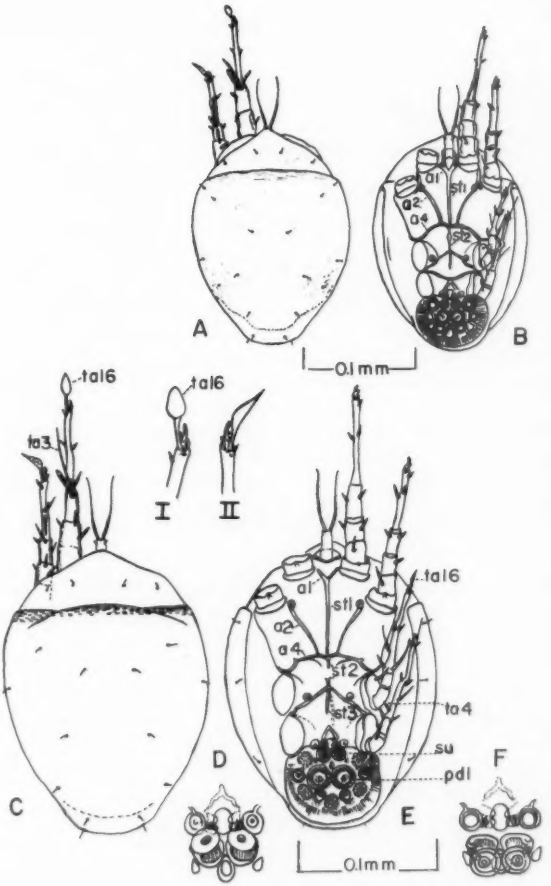

Plate 41 – Upper, *Histiostoma polaki* deutonymph. A – dorsum. B – venter. (Original unpublished drawing by A. C. Oudemans) Lower, *Histiostoma polypori* deutonymph. C – dorsum. Middle, legs I and II. D and F – details of portions of the suctorial plate; D – suckers distended, F – suckers retracted. E – venter. (Original unpublished drawing by A. C. Oudemans)

Histiostoma polypori (Oudemans), 1914

(Plate 41)

Anoetus polypori Oudemans, 1914; *Histiostoma polypori* (Oudemans), 1914 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 41). Length 0.200 mm.; width 0.140 mm. *Venter.* — Fused pedipalps nearly equal to tibia I; pedipalpal seta *ppl* equal to tarsus II. Apodemata *a1* short, joining to form sternum *st1* which makes contact with *a4;* apodeme *a2* meets *a4* apodemata *a4* continuous in midline with *st2;* posterior portion of *st2* forms short "Y"-shaped process; *a5* joins in midline; *st2-st3* united with *a5,* with a membranous portion joining *st4.* Coxal discs *di1-di3* approximately one-half diameter of functional sucker *su;* central suctorial plate discs *pd1* approximately twice the diameter of *su.* Suctorial plate large. *Dorsum.* — Smooth except for anterior margin of hysterosoma which is faintly transversely striated; setae minute, hairlike and equal. Lateral margins of hysterosoma distinctly turned ventrally. *Legs.* — Leg shape, setae size and arrangement similar to *H. julorum,* except: leg I *ta3* equal to tarsus II, *ta16* spoon-shaped; *ta16* legs II-III lanceolate, *ta4* leg IV short, spine-like.

Remarks. — Features most useful in identifying the deutonymph of this species are: length of fused pedipalps and *pp1,* large suctorial plate, arrangement of apodemata, smooth dorsum, minute setae, length of *ta3* leg I, shape of *ta16* legs I-III.

Collections. — Collected by D. MacGillavry on *Polyporus sp.,* Oosterbeck, July 1911; by A. C. Oudemans on *Eugamasus cornutus,* Amsterdam, September, 1900, and on *Forficula auricularia,* Arnhem, August 1900; by G. H. Vitzthum in Weimar, July 1912; by B. K. Behura on *Forficula auricularia,* Edinburgh, 1950.

Types. — Holotype in Oudemans' collection.

Histiostoma prodectoris (Vitzthum), 1920, new combination

(Plate 42)

Anoetus prodectoris Vitzthum, 1920.

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 42). Length 0.156-0.160 mm.; width 0.095-0.100 mm. Shape nearly rectangular. *Venter.* — Fused pedipalps one-half length of tibia II; pedipalpal seta *pp1* nearly twice length of tibia I. Sternum *st1* free; apodeme *a2* free or faintly united with apodeme *a4;* apodemata *a4* joined in midline and continuous with sternum *st3; st3* and *st4* united with apodemata *a5*. Coxal disc *di1* lies on *a2,* and is slightly larger than *di2; di1* and *di2* smaller than *di3* which latter is equal to functional sucker *su. Dorsum.* — Smooth. Setae variable in length; *dp3* twice as long as *dp4; dm2* three times length of other hysterosomal setae except *do4. Legs.* — Shape and relative proportions of segments generally similar to *H. julorum,* except tarsus II is equal to tarsus I; legs I-II *ta16* tapering; *ta16* leg IV longer than in *H. julorum; ta3* leg I two-thirds length of tarsus I.

Remarks. — Features most useful in identifying this species are as follows: relatively short fused pedipalps, long *pp1,* long tarsus I-II, small coxa I-III discs, smooth dorsum with setae variable in length, *dp3* longer than *dp4.* The full complement of dorsal and leg setae not shown or observed by Vitzthum.

Collections. — On *Prodector fruhstorjeri* Senna from Bua-Kraeng in South Celebes, and on *Ectocemus cinnamomeus* Herbst from Luzon, Philippines.

Types. — In Vitzthum's collection.

Histiostoma prophthalmi (Vitzthum), 1920, new combination

(Plate 42)

Anoetus prophthalmi Vitzthum, 1920.

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 42). Length 0.174 mm.; width 0.120 mm. Shape ellipsoid. *Venter.* — Fused pedipalps nearly equal length of tibia II; pedipalpal seta *pp1* one-half length of tarsus I; extends well beyond gnathosoma. Apodemata *a1* short, joining to form *st1* which ends free posteriorly; *a2* ends free; apodemata *a4* continuous in midline and united with *st2;* apodemata *a5* continuous in midline and united with *st2* and *st3*. Coxal discs *di1* lie on *a2,* equal in size to *di2,* less than one-half the size of the functional sucker *su. Dorsum.* — Smooth except faint striation at anterior margin of hysterosoma. *Legs.* — Shape generally sim-

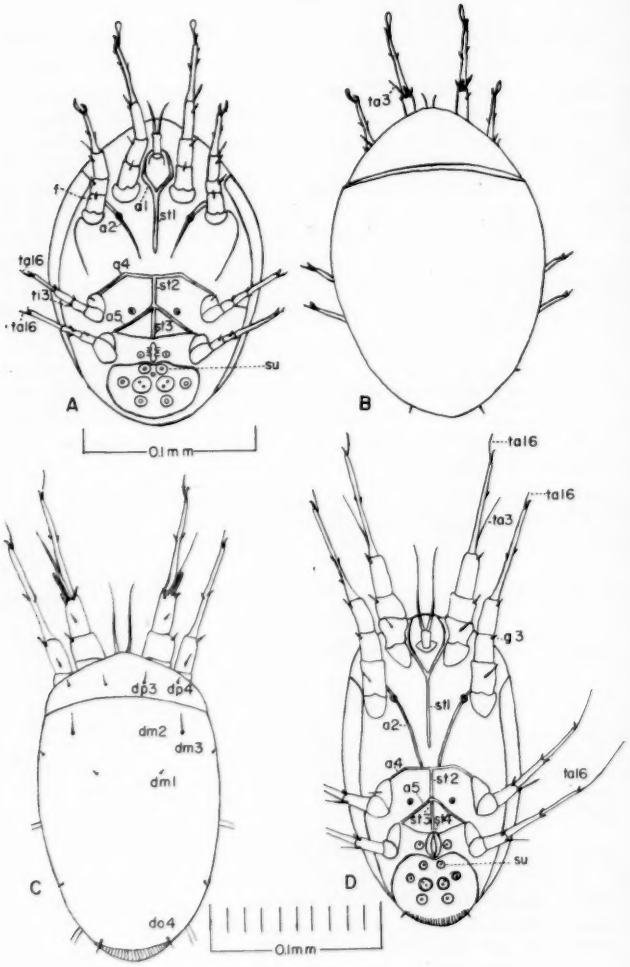

Plate 42 – Upper, *Histiostoma prophthalmi* deutonymph. A – venter. B – dorsum. (After Vitzthum) Lower, *Histiostoma prodectoris* deutonymph. C – venter. D – dorsum (After Vitzthum)

ilar to *H. julorum* except for the shorter tarsus I-II, and shorter and finer legs III-IV; setae differences as follows: leg I *ta3* shorter; leg II *f* one-third as long; leg III *ti3* shorter, *ta16* twice as long as claw; leg IV without long setae, *ta16* equal to claw.

Remarks. — Features most useful in identifying this species are as follows: arrangement of apodemata, coxal discs *di1* lie on *a2*, small, equal to size of *di2*, tarsi I-II short, legs III-IV short and fine; propodosoma extending distinctly beyond short fused pedipalps, *pp1* one-half length of tarsus I. Dorsal setae and leg setae not observed or drawn by Vitzthum.

Collections. — Collected by R. Kleine on *Prophthalmus potens* Lacordaire, in Assam, India.

Types. — Holotype in Vitzthum's collection.

Histiostoma protuberans sp. nov.

(Plates 43, 44)

Female. — (Plate 43). Length 0.400 mm.; width 0.235 mm. *Venter.* — Chelicera finely serrated bearing approximately 10 extremely fine teeth distally, 14 slightly larger proximal teeth borne on expanded region; median member of chelicera short, blunt, and with four rounded toothlike structures distally; cheliceral flagellum shorter and heavier than *H. julorum*. Pedipalpal seta *pp1* anteriorly directed, shorter than most dorsal setae, approximately equal to *dm1*, three times length of *pp2;* distal portion of pedipalps with mesially directed projection. Ventral setae similar in position but generally longer than in *H. julorum* except *vm1* nearly equal, *vm3* mesiad of *r2*, *vo3* shorter. Ringlike structure *r2* small, nearly round, and more heavily sclerotized than in *H. julorum*. *Dorsum.* — Granular and sculptured; rostrum heavily sculptured, hysterosoma very faintly sculptured; lateral and posterior regions of the hysterosoma with distinct elevations which appear to bear numerous smaller bosses, giving a wart-like appearance. By comparison with *H. julorum* the dorsal setae differ as follows: *dp1* one-third as long, *dp2* slightly shorter, *dp3* longer, *dp4* shorter; all hysterosomal setae shorter and finer. Bursa copulatrix slightly posterior to a line between setae *do5*, elongated, and originating from the bottom of a cup-like structure. *Legs.* — Leg shape and setae arrangement similar to *H. julorum* except: leg I *ti2* longer, leg II *g3* longer, *ti2* almost three times as long. Leg III *t* twice as long, *ta9* over twice length of claw; leg IV *f* twice as long, *ta9* over twice length of claw.

Male. — (Plate 43). Length 0.324 mm.; width 0.190 mm. *Venter.* — Gnathosoma as in female. Setae similar in position, and considerably long-

er than in *H. julorum* except; *vm3* anterio-mesiad of posterior ringlike structures *r2*, *vo2* mesiad of *r2*, *vo3* approximately equal in length. Ringlike structures small, nearly round; *r2* on a line with the anus, and surrounded by a faint chitinous structure which is pointed anteriorly. *Dorsum.* — Granular and sculptured, rostrum more heavily sculptured than propodosoma and hysterosoma; hysterosoma with unique elevations as in female. Setae generally somewhat longer than in female. A distinct posteriorly directed elevation or pseudo-bursa, is seen in the position of the true bursa copulatrix of the female. The male of the "bursoid variety" of *H. julorum* also has a pseudo-bursa. Dorsal pit-like structure *dpi3* could not be observed. *Legs.* — All legs heavier than in *H. julorum*, especially legs I-II which are exceptionally gross. Setae similar in position except mid-tarsal setae of leg I more widely separated. Setae differences worthy of note are as follows: leg I *f* and *ta7* heavier; leg II *f*, *ta6* and *ta7* heavier; leg III *t* three times as long, *ta9* over three times length of claw; leg IV *f* twice as long, *ta9* over three times length of claw. All claws heavier than in most anoetids.

Deutonymph. — (Plate 44). Length 0.188 mm.; width 0.139 mm. *Venter.* — Fused pedipalps equal in length to genu I, expanded in mid-region, and not extending beyond base of gnathosoma; seta *pp1* equal to tarsus I. Sternum *st1* free posteriorly; apodeme *a2* faintly united with *a4;* the more chitinous portions of *a4* not united; membranous portions *a4* appear to be united; *st2* short, united with *a5*, and not connected with *a4* anteriorly; *a5* united to *st2-st3* in midline; *st3* and *st4* almost touching. Coxal discs nearly equal in size, somewhat smaller than suctorial plate discs *pd2* and *pd3;* suctorial plate large. *Dorsum.* — Hysterosoma completely and coarsely granular; propodosoma sparsely granular with distinct line of transverse sculpturing. Setae hairlike, one-half the length of tibia II, and equal. *Legs.* — All legs shorter than *H. julorum;* tarsi I-II relatively short. Setae differ from *H. julorum* as follows: leg I *f* longer, *g1*, *g2* finer, *g3* shorter, *ta4* twice as long, mid-tarsal setae more closely grouped; leg II *g1*, *g2* finer, *ta16* nearly spoon-shaped; leg III *t* longer; leg IV *f* shorter; all claws smaller.

Remarks. — Features most useful in identifying this species are as follows: for the adult, the unusual chelicera, anteriorly directed pedipalpal seta *pp1*, comparatively long ventral setae, position of ventral discs and seta *vm3*, unique dorsal elevations, dorsal sculpturing, and terminal tarsal seta *ta9* legs III-IV over twice length of claw; for the female the unusual bursa copulatrix with surrounding cup-like structure, and for the male the unusual "pseudo-bursa"; for the deutonymph, short fused pedipalps expanded in mid-region, pedipalpal setae longer than tarsus II, arrangement of apodemata, and large suctorial plate, the completely granular dorsal hysterosoma and short, hairlike setae of equal length, compara-

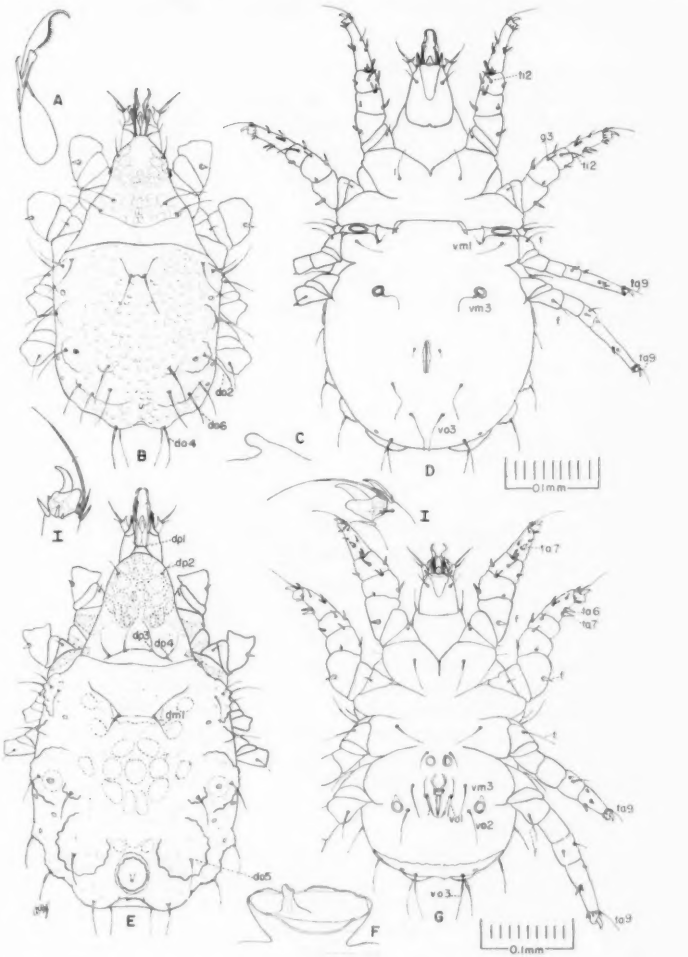

Plate 43 – *Histiostoma protuberans* sp. nov. A – chelicera. B – male, dorsum. C – male, pseudo-bursa copulatrix. D – female, venter. E – female, dorsum. F – bursa copulatrix. G – male venter.

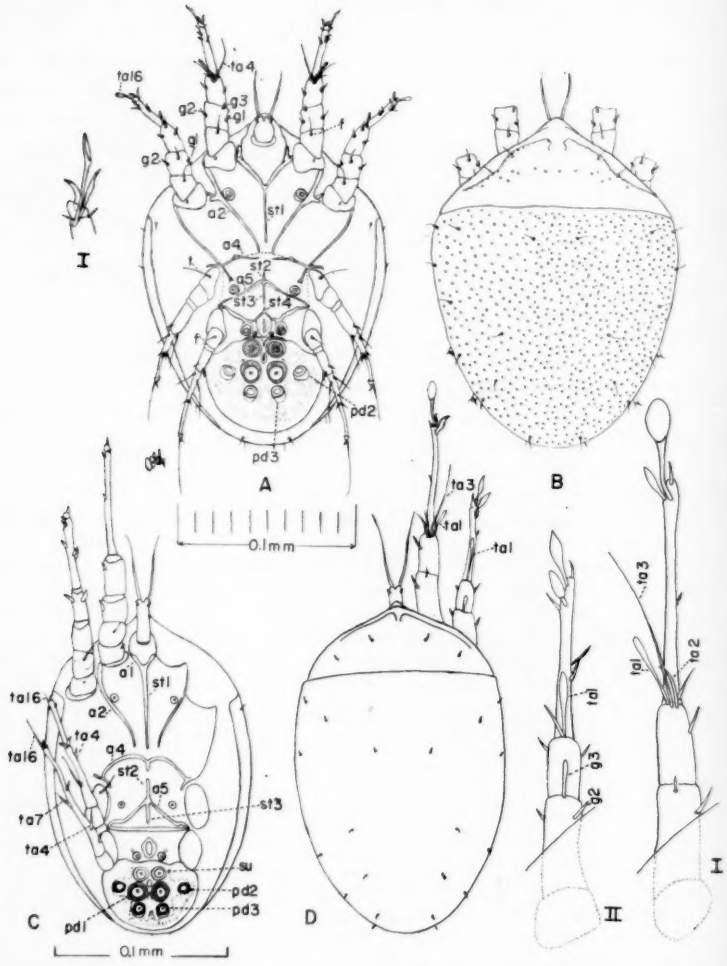

Plate 44 — Upper, *Histiostoma protuberans* sp. nov. deutonymph. A — venter. B — dorsum. Lower, *Histiostoma sapromyzarium* deutonymph. C — venter. D — dorsum. Right, legs I and II. (After Oudemans)

tively short legs, relatively short tarsi I-II, *ta4* leg I extremely long. This species is arrhenotokous.

Collections. — Collected by C. O. Goode near University of Richmond, 8 miles west of Richmond, Va., October, 1950; by R. D. Hughes at Norris Dam, Tenn., July 1951 and in Chickahominy Swamp, near Elferson, Va., June, 1953.

Types. — Holotype and paratypes in U. S. National Museum, Washington, D. C. Paratypes in authors' collection.

Histiostoma pyriforme Michael, 1901

(Plate 45)

Female. — (Plate 45). Length 0.300 mm.; width 0.130 mm. Pear-shaped. *Venter.* — Chelicera bearing approximately 18 equal teeth; cheliceral flagellum extending nearly to end of chelicera. Pedipalpal seta *pp1* three times length of *pp2; pp2* equal to genu I. Ringlike structures nearly circular. *Dorsum.* — Smooth, except for faintly sculptured rostrum. Propodosomal seta *dp4* one-third longer than *dp3;* hysterosomal setae twice as long as *dp4,* except *dm4. Legs.* — Legs II-IV longer and setae all legs generally larger than *H. julorum.* Terminal tarsal setae *ta9* legs III-IV longer than tarsi III-IV. Claws long and nearly straight.

Male. — (Plate 45). Length 0.250 mm.; width 0.120 mm. Shape oblong. *Venter.* — Gnathosoma as in female. The ventral setae shown are spine-like, not long and tapering as in *H. julorum.* Ringlike structures nearly circular; *r2* widely separated, opposite genitalia. *Dorsum.* — No figure; presumed to be similar to female. *Legs.* — Legs generally heavier than female; setae similar including the extremely long terminal tarsal setae *ta9* legs III-IV. Leg I with claw-shaped terminal tarsal seta typical of this family, described but not shown in Michael's figure. (cf. Plate 5 – seta *ta15*). Claws long and nearly straight.

Deutonymph. — No information.

Remarks. — Features most useful in identifying this species are the serrated chelicera, long pedipalpal seta *pp1,* and the extremely long terminal tarsal setae on all legs. Michael found that most of the specimens were covered on the dorsal surface with living Vorticellidae. This probably accounts for his failure to observe many dorsal and leg setae.

Collections. — In exuded sap and decaying debris on beech trees, *Fagus sylvatica.* Collected by A. D. Michael, probably in England, 1901.

Types. — No record.

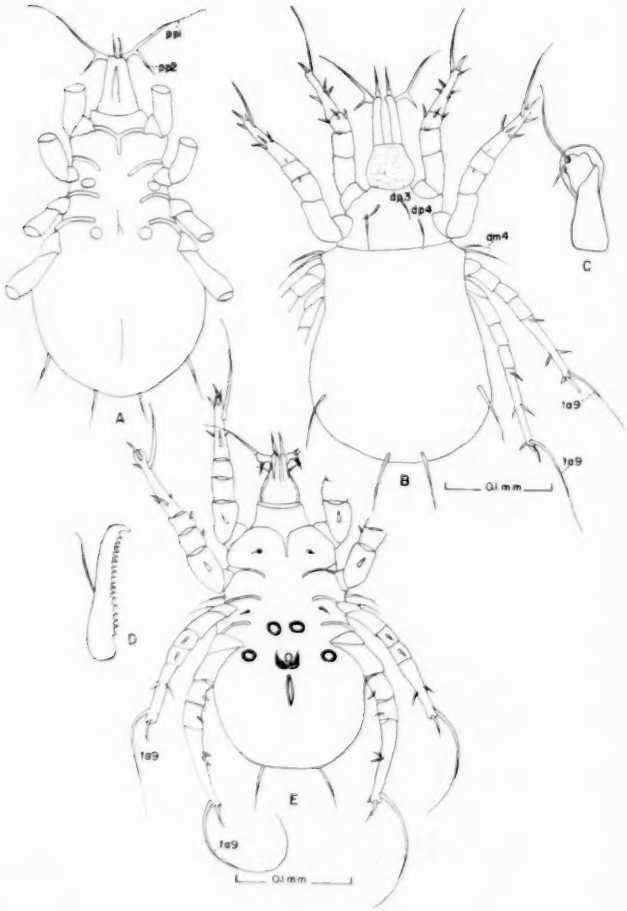

Plate 45 – *Histiostoma pyriforme*. A – female, venter. B – female, dorsum. C – pedipalp. D – chelicera. E – male, venter. (After Michael)

Histiostoma sapromyzarum (Dufour), 1839

(Plate 44)

Hypopus sapromyzarum Dufour, 1839; *Anoetus sapromyzarum* (Dufour), 1839 [Oudemans, 1914b]; *Histiostoma sapromyzarum* (Dufour), 1839 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 44). Length 0.187 mm.; width 0.120 mm. *Venter.* — Fused pedipalps slightly longer than tibia I; pedipalpal seta *pp1* nearly one-third longer than fused pedipalps, shorter than tarsus II. Apodemata *a1* short, fusing to form *st1* which is free posteriorly; apodeme *a2* slightly "S"-shaped, ends free; apodemata *a4* slightly arched on each side united in midline with short anterior portion of *st2;* anterior and posterior portions of *st2* separated; *a5* united in midline with *st2* and *st3*. Coxal discs smaller than suctorial plate discs or suckers; functional sucker *su* equal to *pd2* and *pd3*, and smaller than *pd1*. *Dorsum.* — Smooth except for single transverse line of sculpturing at anterior margin of propodosoma. Setae minute, hairlike, and equal. *Legs.* — Legs generally similar in size and shape to *H. fulorum*, setae differences as follows: leg I *ta1* longer, *ta3* much longer; leg II *ta1* longer; leg III *ta4* shorter and more spine-like, *ta16* less than twice length of claw; leg IV *ta4*, *ta7*, and *ta16* shorter.

Remarks. — Features most useful in identifying this species are as follows: shape of fused pedipalps, length of pedipalpal setae, arrangement of apodemata, size of coxal discs, smooth dorsum except for anterior line of sculpturing on propodosoma, minute and equal dorsal setae, shape of *ta15* and *ta16* legs I-II, long *ta3* leg I, long *ta1* leg II and relatively short *ta16* leg III. One dorsal seta and many leg setae are not shown in Oudemans' drawings. Oudemans in 1924 stated that *Hypopus filicum* Dujardin, 1849 was a synonym of this species. In 1937 he placed *Hypopus filicum* in the genus *Myianoetus*.

Collections. — Collected by Dufour in *Sapromyzae blepharipteroides*, 1839; in Netherlands, Italy, and France, and on rotting hyacinth bulb, San Remo, Italy, Oudemans 1914; on *Dryocetes autographus* Ratz, from wood-farm on the Thaya, Neiderosterreich, Vitzthum, 1923; by Dr. Stadler in the nest of the bank swallow *Clivicola riparia*, at Lohram-Main, 1924, on *Schizotrachelus bakeri* Klein, from Philippines, on *Brenthus* from Bolivia and on *Phoeborus scaber* Erichson, from Brazil, Vitzthum, 1926.

Types. — Holotype in Oudemans' collection.

Histiostoma sextoni sp. nov.

(Plates 46, 47)

Female. — (Plate 46). Length 0.440 mm.; width 0.255 mm. Pear-shaped. *Venter.* — Chelicera finely serrated bearing approximately 18 equal teeth; median cheliceral process forked; lateral process short, equal to *pp2*, not flagella-like as in most anoetids. Pedipalpal seta *pp1* short, anteriorly directed, three times length of *pp2*. Setae similar in arrangement, generally slightly shorter than *H. julorum* except *vo1* slightly longer, and *vo2* equal; *do7* ventral in position. Ringlike structure *r2* clongated; *vm3* posterior to *r2*. *Dorsum.* — Dorsum smooth except for sculptured rostrum. Setae considerably longer than in *H. julorum*, except *dp1* which is equal. Bursa copulatrix on a line with *do5*, raised, granular, and opening posteriorly. *Legs.* — Similar in size, shape, and setae arrangement to *H. julorum*, with minute differences in setae size. Terminal tarsal setae *ta9* legs I-IV nearly equal and longer than claw. All claws larger, and less curved than *H. julorum*.

Male. — (Plate 46). Length 0.300 mm.; width 0.140 mm. Shape nearly rectangular. *Venter.* — Entire gnathosoma smaller than in *H. julorum*, similar to female except smaller. Setae slightly longer than *H. julorum*, except *vm1* and *vo2* equal. Position of setae similar to *H. julorum* except *vm3* posterio-mesiad to ringlike structure *r2*, and *vo1*, *vo2* more posterior. Anterior ringlike structure *r1* round or oval, *r2* elongated, widely separated, and on a line with external genitalia. *Dorsum.* — Smooth except for sculptured rostrum. All setae considerably longer than *H. julorum*, except *dp1* slightly longer. *Legs.* — Leg shape, size and setae arrangement similar to *H. julorum*, except terminal tarsal setae *ta9* legs III-IV longer than claw, *t* and *ti2* legs I-II longer, and claws longer and less curved.

Deutonymph. — (Plate 47). Length 0.158 mm.; width 0.122. *Venter.* — Fused pedipalps one-half length of tarsus I; pedipalpal seta *pp1* equal to fused pedipalps. Sternum *st1* sometimes appears to be connected by faint membranous portion to *a4*; apodeme *a2* faintly continuous with *a4*; apodemata *a4 sometimes* appear to be joined in midline; *st2* free anteriorly, posteriorly joined to united apodemata *a5*; *st3* thin, contiguous with *st4*. Coxal discs somewhat smaller than suctorial plate discs *pd2* and *pd3*. *Dorsum.* — Smooth except for three transverse lines of sculpturing on the anterior propodosoma, and transverse striations on the anterior margin of the hysterosoma. Most dorsal setae equal or nearly equal in length to genu I; *do3*, *do4*, and *do6* approximately one-half as long. *Legs.* — Tarsi I-II equal to combined length of femur, genu, and tibia. Setae generally smaller than *H. julorum*, except: *ta1*-*ta3* leg I, and *ta1* leg II which are longer. Seta *ta3* leg I equal to tarsus II. Seta *ta16* legs I-II lancet-shaped.

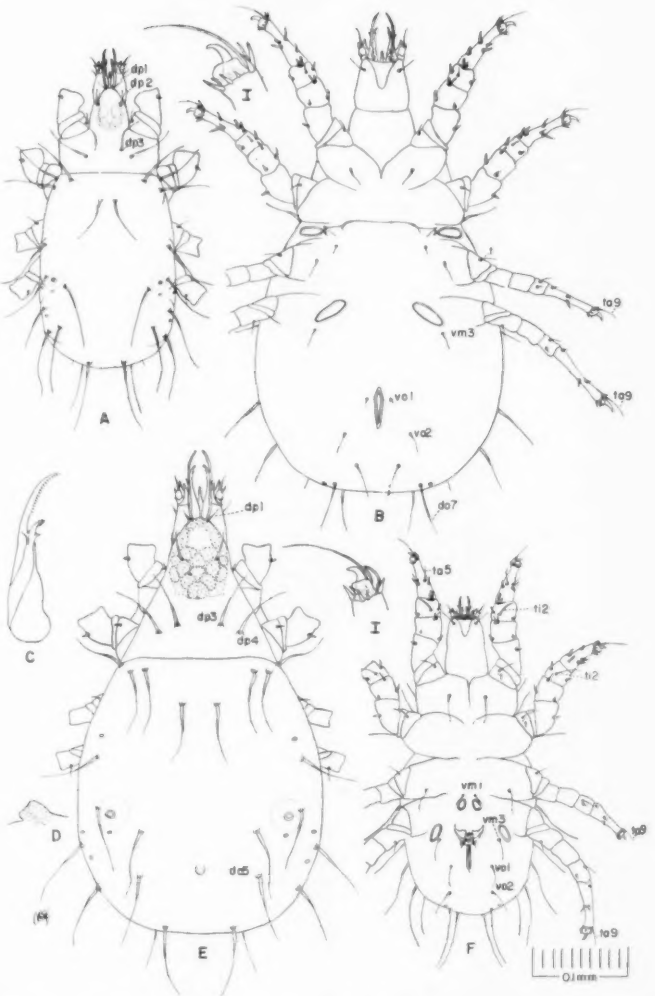

Plate 46 – *Histiostoma sextoni* sp. nov. A – male, dorsum. B – female venter. C – chelicera. D – bursa copulatrix. E – female, dorsum. F – male, venter.

Remarks. — The combination of adult characteristics most useful in identifying this species is as follows: finely serrated chelicera, lateral cheliceral process not flagellum-like, short anteriorly directed pedipalpal seta *pp1*, elongated ringlike structures *r2*, smooth dorsum except for rostrum, long terminal tarsal seta *ta9* legs III-IV, and unusually long dorsal setae. For the female *vm3* posterior to *r2*, and bursa copulatrix raised and directed posteriorly; for the male *vm3* mesiad and posteriad of *r2*. Features most useful in identifying the deutonymph are as follows: fused pedipalps and pedipalpal setae equal in length, arrangement of apodemata, size of coxal discs, three lines of sculpturing on the dorsal propodosoma, transverse striations on the dorsal anterior hysterosoma, most dorsal setae equal or nearly equal in length to genu I, seta *ta3* leg 1 equal to length of tarsus II and *ta16* legs I-II lancet-shaped. This species is named in honor of Roy L. Sexton.

Collections. — Collected by R. D. Hughes in Chickahominy Swamp, near Ellerson, Va., October, 1951 and August, 1953, and in duck pen near Ellerson, Va., August, 1955.

Types. — Holotype and paratypes in U. S. National Museum, Washington, D. C. Paratypes in authors' collection.

Histiostoma spinitarsus (Oudemans), 1901

(Plate 48)

Hypopus spinitarsus Oudemans, 1901; *Anoetus spinitarsus* Oudemans, 1917; *Histiostoma spinitarsus* (Oudemans), 1901 [Buitendijk, 1945]

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 48). Length 0.143 mm.; width 0.099 mm. *Venter.* — Fused pedipalps equal to tibia I; pedipalpal seta *pp1* equal to tarsus II. Apodemata *a1* heavily sclerotized at base of trochanters I, united to form sternum *st1* which continues posteriorly and is joined with *a4* by a fainter portion; apodeme *a2* heavily sclerotized at base of trochanters I-II and joins with *a4 posteriorly;* apodemata *a4* join in midline; sternum *st2* continuous with *a4* and *a5; st3* free posteriorly. Coxal disc *di1* lies on the heavily sclerotized anterior extension of *a2*, slightly smaller than *di2; di3* larger than *di2*. Suctorial plate large, circular, otherwise similar to *H. julorum. Dorsum.* — Propodosoma sparsely pitted; hysterosoma heavily pitted, transversely striated anteriorly. Setae *dm1* and *do1* lancet-shaped equal to tarsus II; other setae fine and variable in length. *Legs.* — Leg size and arrangement similar to *H. julorum*, ex-

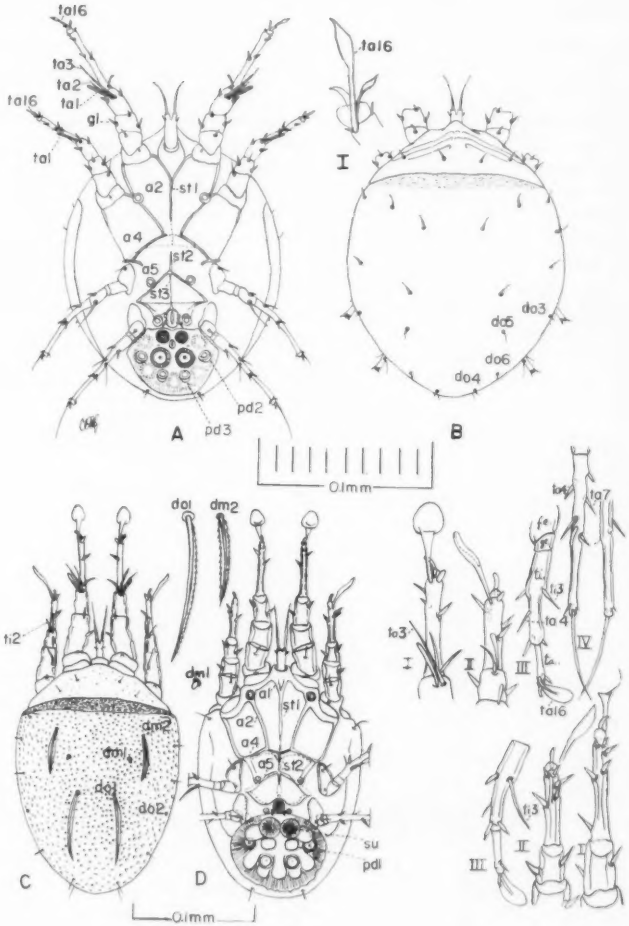

Plate 47 – Upper, *Histiostoma sextoni* sp. nov. deutonymph. A – venter. B – dorsum. Lower, *Histiostoma tienhoveni* deutonymph. C – dorsum. Middle, seta *do1*, *dm2*, and *dm1*. D – venter. Right, legs I-IV (Original unpublished drawing by A. C. Oudemans)

cept *g3* leg I longer, *ti2* leg II longer, no long setae on leg IV. All legs with claws.

Remarks. — Features most useful in identifying this species are: the heavily sclerotized ventral areas adjacent to trochanters I-II, the heavily sclerotized area surrounding *di2*, unusual coxal discs which Oudemans describes as short club-shaped organs, arrangement of apodemata, large and nearly round suctorial plate, pitted soma, hysterosoma transversely striated anteriorly, and two pairs of long lancet-shaped setae on dorsum. Oudemans stated that the two specimens examined by him were defective. This may account for the two missing dorsal setae and for the absence of *ta16* leg IV. Oudemans in about 1910 examined 5 specimens similar to this species collected by Berlese in rotting wood in Florence. Because of the similarity of *H. spinitarsus* he called them *Hypopus tarsispinus*. Because of the inadequate description of these specinens, *Hypopus tarsispinus* is considered by the present authors to be a *nomen dubia*. According to Oudemans this form differs from *H. spinitarsus* as follows: longer fused pedipalps, legs slenderer, setae generally longer.

Collections. — Collected by H. J. Veth on *Phanaeus sp.* (Coprinae), South America, February, 1903.

Types. — In Oudemans' collection.

Histiostoma tienhoveni (Oudemans), 1926

(Plate 47)

Anoetus tienhoveni Oudemans, 1926; *Histiostoma tienhoveni* (Oudemans), 1926 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 47). Length 0.187 mm.; width 0.127 mm. *Venter.* — Fused pedipalps equal length of tibia II; pedipalpal seta *pp1* equal length of tarsus II. Gnathosomal base surrounded by heavily sclerotized apodemata *a1*, which join in midline to form sternum *st1; st1* faintly joined to *a4;* heavily sclerotized portion of apodeme *a2* adjacent to trochanters I-II anteriorly; posteriorly *a2* united with *a4; a4* united in midline with *st2; a5* united and joined with *st2* and *st3*. Coxal disc *di1* lies on the heavily sclerotized anterior end of *a2*, and is larger than *di2-di3*. Suctorial plate almost circular; functional suckers *su* larger than in *H. julorum,* central discs *pd1* smaller. *Dorsum.* — Gnathosomal base extended anteriorly beyond propodosoma; propodosoma finely pitted;

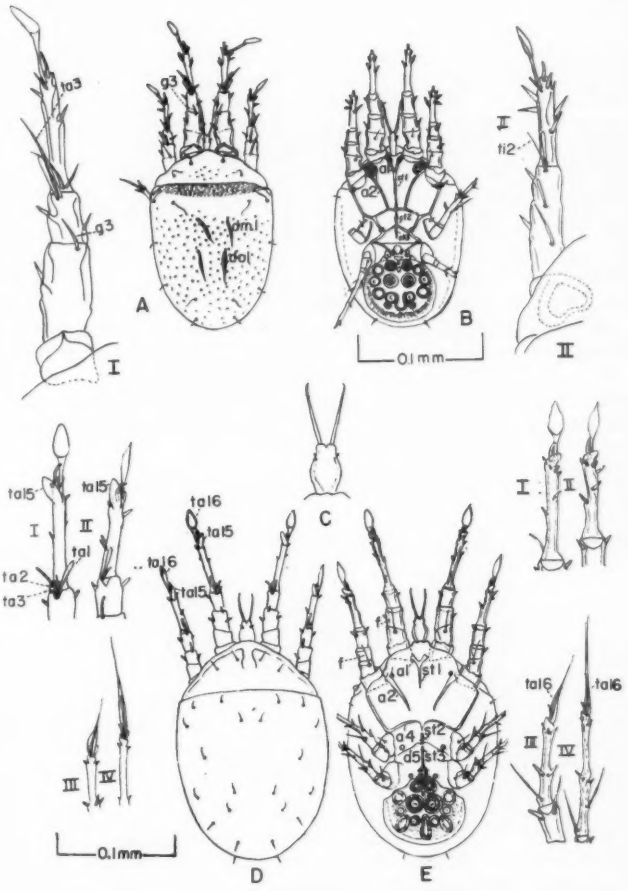

Plate 48 — Upper, *Histiostoma spinitarsus* deutonymph. Left, leg I. A — dorsum. B — venter. Right, leg II. (Original unpublished drawing by A. C. Oudemans) Lower, *Histiostoma toxopei* deutonymph. Left, legs I-IV, dorsal view. C — fused pedipalps. D — dorsum. E — venter. Right, legs I-IV, ventral view. (After Oudemans)

hysterosoma heavily pitted, with anterior margin transversely striated. All setae relatively short, hairlike, except *dm1* which is short and peg-like; *dm2* lancet-shaped, longer than tarsus II, with definite midrib and serrated edges; *do1* lancet-shaped, longer than tarsus I, with one margin serrated; and *do2* small, probably peg-like. *Legs.* — Tarsi I-II shorter than combined length of trochanter, genu, and tibia; otherwise leg size, shape, and arrangement similar to *H. julorum*, except: *ti2* leg II longer; leg III *ta4* shorter, *ta16* unstalked, membranous, rounded distally; leg IV *ta4-ta7* shorter; terminal tarsal seta, which probably represents a modified claw, long and tapering.

Remarks. — Features most useful in identifying this species are heavy anterior apodemata, *di1* on sclerotized anterior portion of *a2* and larger than other coxal discs; arrangement of apodemata, nearly circular suctorial plate, and size of functional suckers; dorsum pitted, hysterosoma with transversely striated anterior margin, serrated lancet-shaped hysterosomal setae; leg III *ta16* membranous, leg IV terminal tarsal seta long and tapering. It is possible that the unusual peg-like *dm1* actually represents a broken seta. The details of the central suctorial plate disc *pd1* are not shown in Oudemans' figure. It probably is larger than represented.

Collections. — In nest of *Talpa europaea*, Naardermeer, September, 1926.

Types. — One example in Museum Natura Artis Magistra, Amsterdam.

Histiostoma toxopei (Oudemans), 1927

(Plate 48)

Anoetus toxopei Oudemans, 1927; *Histiostoma toxopei* (Oudemans), 1927 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 48). Length 0.184 mm.; width 0.126 mm. Shape ellipsoid. *Venter.* — Fused pedipalps equal to tibia II, expanded in middle; pedipalpal setae equal fused pedipalps. Apodemata *a1* joining to form short sternum *st1;* apodeme *a2* nearly twice length of *st1, a1* and *a2* free posteriorly; apodemata *a4* united in midline and join sternum *st2;* apodemata *a5* weak, join in midline to form *st2; st2* contiguous with *st3; st3* and *st4* continuous. Coxal discs small and equal. Suctorial plate with irregular anterior margin. *Dorsum.* — Smooth except for single line

of sculpturing on anterior margin of propodosoma. Setae short, hair-like, and equal. *Legs.* — Tarsi I-II relatively short; otherwise leg size and shape, and leg setae size and arrangement similar to *H. julorum*, except: *tal5* legs I-II unstalked, membranous, wide at base, with rounded tips; *tal6* legs III-IV broad at base, but finely tapering; leg I *ta2-ta3* less than one-half length of *tal;* legs I-II seta *f* longer.

Remarks. — Features most useful in identifying this species are expanded fused pedipalps equal in length to pedipalpal setae, arrangement of apodemata, small coxal discs, and shape of suctorial plate; dorsum smooth with single line sculpturing on anterior propodosoma, short equal setae; leg setae *tal5* I-II membranous, *ta2* and *ta3* leg I short.

Collections. — Collected by A. C. Oudemans on stretches between Wai Eno and Wai Temun, Insel Buru, February, 1921.

Types. — No record.

Histiostoma trichophorus (Oudemans), 1912

(Plate 49)

Anoetus trichophorus Oudemans, 1912; *Histiostoma trichophorus* (Oudemans), 1912 [Buitendijk, 1945].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 49). Length 0.175 mm.; width 0.108 mm. *Venter.* — Fused pedipalps equal in length to tibia I; pedipalpal setae equal to tarsus II. Sternum *st1* free posteriorly; apodemata *a4* joined in midline and united with *a2;* sternum *st2* extended anteriorly to united posterior portion of *a4;* apodemata *a5* united in midline with *st2* and *st3*. Coxal disc *di1* lies on *a2*, is slightly smaller than *di2* and *di3*. Suctorial plate ellipsoidal. *Dorsum.* — Smooth. Setae hairlike, generally equal or longer than tibia I, except *do3*, *do4*, and *do6* which are much shorter. Seta *dp3* slightly shorter than *dp4*. *Legs.* — Leg size, shape, and setae size and arrangement similar to *H. julorum*, except: *ti2* leg II much longer; *ta4* leg IV shorter, leg IV without claw.

Remarks. — Features most useful in identifying this species are length of fused pedipalps and pedipalpal setae *pp1*, arrangement of apodemata, shape of suctorial plate, hairlike dorsal setae generally as long or longer than tibia I. Vitzthum (1923) described an anoetid which he called *H. trichophorus* Oud. although there was some doubt in Vitzthum's mind that his specimens corresponded exactly with this species. In some features his specimens resembled *H. himalayae*. A similar form with pit-

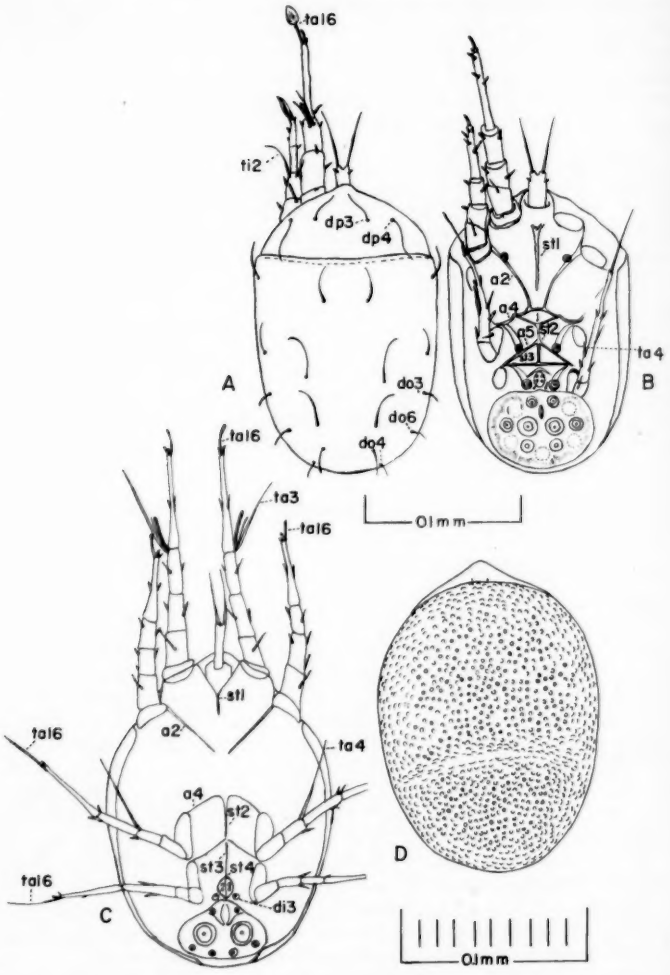

Plate 49 — Upper, *Histiostoma trichophorus* deutonymph. A — dorsum. B — venter. (Original unpublished drawing by A. C. Oudemans) Lower, *Anoetostoma oudemansi* deutonymph. C — venter. D — dorsum. (After Womersley)

ted dorsal hysterosoma was also observed by Vitzthum in 1921.

Collections. — Collected by A. C. Oudemans on *Platypus dispar* Schauff II (Platypodidae), Mkulumusi Mountain, near the Biological Agricultural Institute, Amani, Dutch East Africa, July, 1911; by Vitzthum in Blankenese, Holstein, August, 1911; by H. Wichmann on *Dendroctonus micans* Kug., wood farm on the Thaya, July, 1920; by Vitzthum on *Hormocerus reticulatus* at Sumbava, Dutch Indies; by A. Krausse under bark of decaying tree trunk at Eberswalde, April, 1921.

Types. — Holotype in Natural History Museum at Hamburg, Germany.

GENUS *Anoetoglyphus* Oudemans, 1927

Diagnosis of genus. — Diagnosis is based on deutonymph (Oudemans, 1929). Coxa I with distinct disc *di1;* coxa III devoid of either a disc or seta. Coxa IV with disc *di3*. Suctorial plate with 2 functional suckers, 2 large central discs, and 4 small discs. (Oudemans 1927, Vitzthum 1927).

Type. — *Anoetoglyphus ateuchi* Oudemans, 1927.

Anoetoglyphus ateuchi Oudemans, 1927

Female. — No information.

Male. — No information.

Deutonymph. — (No published figure). *Venter.* — Coxa I with disc *di1;* coxa III devoid of a disc or seta. Coxa IV with disc *di3*. The row of 4 small discs on the suctorial plate is posteriad of the large central discs. Suctorial plate sucker-disc arrangement is then by rows 2.2.4, not 2.4.2 as in many anoetids. *Dorsum.* — Propodosoma smooth. Hysterosoma with extremely fine pores. Dorsal setae short. *Legs.* — Tarsal setae *ta16* legs I and II leaf-shaped; seta *ta16* leg III palette-shaped; leg IV without long *ta16*.

Remarks. — Because of the variability of the sucker-disc arrangement on the suctorial plate within the single genus *Anoetus,* for example, it is doubtful that the arrangement 2.2.4 will have diagnostic value for this genus, as Oudemans suggests.

Collections. — On larva of *Ateuchus semipunctatus* F., South Italy.

Types. — In Oudemans' collection (one slide with 4 deutonymphs sent to Oudemans by Vitzthum).

GENUS *Anoetostoma* Womersley, 1941

Diagnosis of genus. – Diagnosis is based on deutonymph. Coxa I and III devoid of either discs or setae. Coxa IV with disc *di3*. Suctorial plate with two functional suckers, 2 large central discs, and 4 small discs. (Womersley states that no dorsal sulcus is present, yet in figure he clearly shows a coarsely granular hysterosoma and a short smooth propodosoma, thus indicating a sulcus is actually present.)

Type. – *Anoetostoma oudemansi* Womersley, 1941.

Anoetostoma oudemansi Womersley, 1941

(Plate 49)

Female. – No information.

Male. – No information.

Deutonymph. – (Plate 49). Length 0.165 mm.; width 0.126 mm. *Venter.* – Fused pedipalps equal to length of tibia I. Suctorial plate ellipsoidal with two functional suckers, not described by Womersley but shown in his figure. Suctorial plate sucker-disc arrangement is 2.2.4 as in *Anoetoglyphus ateuchi* rather than 2.4.2 as in many other anoetids. Sternum *st1* short, not touching apodeme *a4*. Apodemata *a4* continuous in midline with sternum *st2*. Sterna *st2*, *st3*, and *st4* continuous. *Dorsum.* – Evidence of dorsal sulcus as described for genus. Hysterosoma coarsely granular. Dorsal setae probably minute, not observed by Womersley. *Legs.* – All tarsi with small claws. Tarsal setae *ta16* legs I-II clavate, legs III-IV *ta16* more than four times as long as claw; leg IV *ta4* unusually long.

Remarks. – The functional suckers were not recognized by Womersley. In all observed anoetids these are often distended in such a position as to be difficult to observe. In view of lack of many details in Womersley's description of *Anoetostoma oudemansi*, it is believed that setae on coxae I-III, and seta *vm1* associated with coxal disc *di3*, may have been present but not observed because of their minute size. If such setae are observed in the future by more detailed study, then this species would be placed in the genus *Anoetus*. However, since the presence of such setae is conjectural at this time, the genus *Anoetostoma* is retained. It may be noted that many leg setae are not shown. Features useful in identifying the deutonymph of this species are as follows: length of fused pedipalps and seta *pp1*, arrangement of apodemata, arrangement of suctorial plate, granular dorsum, short propodosoma, leg I *ta3* longer than tarsus II, and leg IV *ta4* exceptionally long.

Collections. — On *Musca domestica*, Sidney, New South Wales, June, 1940.

Types. — Probably in museum in Adelaide, Australia.

KEY TO THE SPECIES OF THE GENUS *Anoetus* BASED ON MALES

1. With a pair of posterio-marginal seta longer than hysterosoma ..... *A. nepenthesiana*
   Without extremely long posterio-marginal setae 2
2. Pedipalpal seta *pp1* long, flagella-like; longer than tarsus I ..... *A. bushlandi*, sp. nov.
   Pedipalpal seta *pp1* shorter than tarsus I 3
3. Dorsal hysterosomal setae of unequal length; seta *dm1* one-half, or less, length of others ..... *A. gibsoni*
   Dorsal hysterosomal setae approximately equal in length ..... *A. laboratorium*

KEY TO THE SPECIES OF THE GENUS *Anoetus* BASED ON FEMALES

1. Pedipalpal seta *pp1* very long, flagella-like, longer than tarsus I ..... *A. bushlandi*, sp. nov.
   Pedipalpal seta *pp1* shorter than tarsus I 2
2. Claws long, tapering; over one-half length of tarsus I ..... *A. gibsoni*
   Claws short, stout; length less than one-fourth tarsus I *A. laboratorium*

KEY TO THE SPECIES OF THE GENUS *Anoetus* BASED ON DEUTONYMPHS

1. Apodemata *a2* not continuous with apodemata *a4* 8
   Apodemata *a2* continuous with apodemata *a4* 2
2. Sternum *st1* continuous with apodemata *a4* 3
   Sternum *st1* not continuous with apodemata *a4* 5
3. Most dorsal setae, long, hairlike ..... *A. polynesiacus*
   Most dorsal setae short 4

4. Plate disc *pd1* much larger than functional sucker *su;* tarsus III with paired distal membranous structure ..... *A. turcastanae*
   Plate disc *pd1* almost equal in size to functional sucker *su;* tarsus III without paired distal membranous structure
   A. heliocopridis

5. Dorsal hysterosoma smooth 6
   Dorsal hysterosoma striated or shagreened 7

6. Leg IV with typical claw ..... *A. conclavicola*
   Leg IV without typical claw ..... *A. alicola*

7. Leg IV without typical claw ..... *A. laboratorium*
   Leg IV with typical claw ..... *A. bushlandi,* sp. nov.

8. Apodemata *a5* free, not meeting to form *st2* ..... *A. gibsoni*
   Apodemata *a5* not free, meeting to form *st2* ..... *A. nepenthesiana*

GENUS *Anoetus* Dujardin, 1842

Diagnosis. — Diagnosis is based on deutonymph. Coxae I and III with minute setae. Coxa IV with seta *vm1*, mesiad of disc *di3*. Suctorial plate with two functional suckers, two large central discs, and four small discs. (Oudemans, 1929; Gervais, 1844).

Type. — *Anoetus alicola* (Dujardin), 1849.

Anoetus laboratorium (Hughes), 1950, new combination

(Plates 50, 51)

Histiostoma laboratorium Hughes, 1950

Female. (Plate 50). Length 0.460 mm.; width 0.310 mm. *Venter.* — Chelicera serrated, bearing approximately eight teeth equal in length, with blunt or rounded ends; toothed region bearing seta-like structure ending in minute but distinct knob. Lateral chelicercal flagellum equal in length to toothed region. Pedipalpal seta *pp1* slightly longer than *pp2*. Laterally pedipalps bear many fine bristle-like structures. By comparison with *H. julorum* the following outstanding differences may be noted: setae more spine-like, except *vo3;* ring-like structures *r2* somewhat smaller, often almost triangular in shape, but variable in different specimens. *Dorsum.* — Smooth except rostrum, which is granular giving sculptured effect. Setae longer than tarsus I, tapering, except setae *dp1*, *dp2*, and *dp3*. Bursa copulatrix on line between excretory pores; slightly raised from surface of dorsum with opening in middle. Dorsal pits as in

H. julorum. Legs. — Leg shape, setae number, and arrangement similar to *H. julorum,* except seta *t* legs I-III nearly twice as long, leg I *g3, g4, ti2, ta1, ta2* and *ta6* larger; leg II *ti2* larger.

Male. — (Plate 50). Length 0.380 mm.; width 0.230 mm. Distinctly broad and shield-shaped. *Venter.* — Gnathosoma same as in female. By comparison with *H. julorum,* seta *vp1* shorter; *vm2* closer to lateral margin of coxa III; *vo2* more minute; *vo3* shorter; ring-like structures *r1* more widely separated, near coxae III, *r2* more widely separated, on level with posterior end of anus. Sclerotized structure associated with *a8. Dorsum.* — Smooth, except rostrum which is granular and sculptured, similar to female. Number, arrangement, and size of setae similar to female. *Legs.* — By comparison with female *A. laboratorium* and with male *H. julorum,* legs distinctly more massive; number of setae same; arrangement of setae similar, but generally much heavier. Legs IV extended posteriorly and apparently functionless as walking appendages, but used to grasp female during copulation.

Deutonymph. — (Plate 51). Length 0.180 mm.; width 0.140 mm. Color pink. *Venter.* — Pedipalpal seta *pp1* longer than tarsus I. Fused pedipalps short, barely extending beyond propodosoma. Coxae I and III setae extremely minute and difficult to see. Coxal IV seta *vm1* extremely minute, mesiad of *di3.* Apodemata *a1* with heavy anterior supporting processes lateral to gnathosomal base; sternum *st1* not making contact with apodemata *a4;* apodeme *a2* joining *a4;* apodemata *a4* continuous in midline; sternum *st2* faintly Y-shaped anteriorly, not joining *a4;* suctorial plate nearly rectangular, and without radial striations marginally. *Dorsum.* — Propodosoma smooth; hysterosoma striated or pitted; setae small, spine-like. Propodosomal setae equal in length; hysterosomal setae one-half length of similar setae in *H. julorum. Legs.* — Setae arrangement and number typical. By comparison with *H. julorum* there are the following striking differences: leg I seta *f* three times as long, *g2* finer, *ta3* longer, *ta15* small, difficult to see; leg II *f* longer, *ta16* tapering, not lancet-like. Leg IV *ta4* and *ta7* much shorter. What appears to be the longer terminal *ta16* leg IV is believed to represent an extremely modified claw, a condition more extreme than that found in *Anoetus gibsoni.* Seta *ta16* is thought to be represented by one of the smaller distal setae. Leg IV is usually extended posteriorly in an immobile position, and is essentially non-functional.

Remarks. — The combination of adult characteristics most useful in identifying this species is as follows: serrated chelicera with blunt teeth; knobbed seta on distal chelicera; short pedipalpal seta; bristle-like srtuctures associated with pedipalps; for the female nearly triangular discs *r2* with setae *vm3* posterior and lateral; small rounded bursa copulatrix on a line with seta *do1;* for the male position of seta *vm1* anterio-laterad of

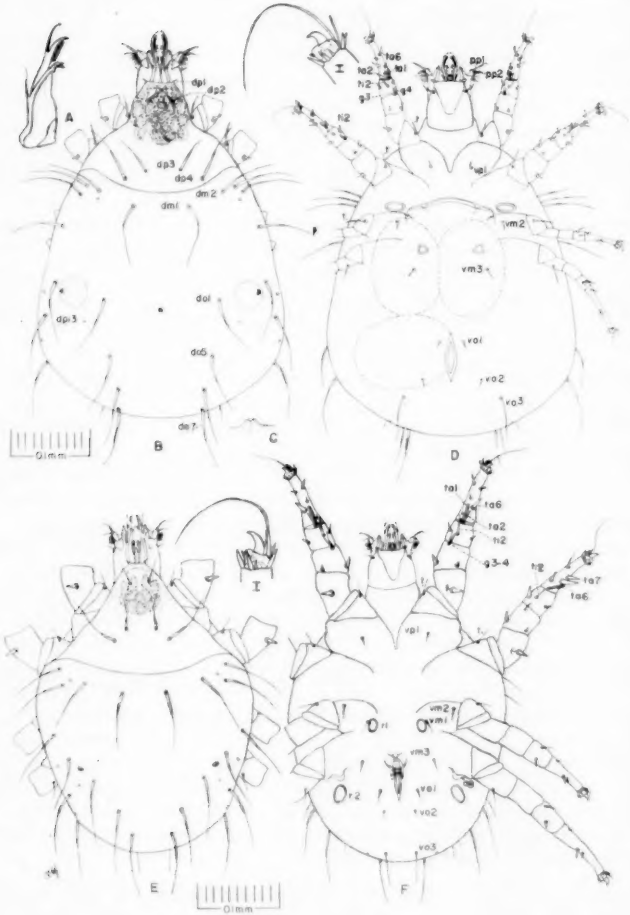

Plate 50 – *Anoetus laboratorium*. A – chelicera. B – female, dorsum. C – bursa copulatrix. D – female, venter. E – male, dorsum. F – male, venter.

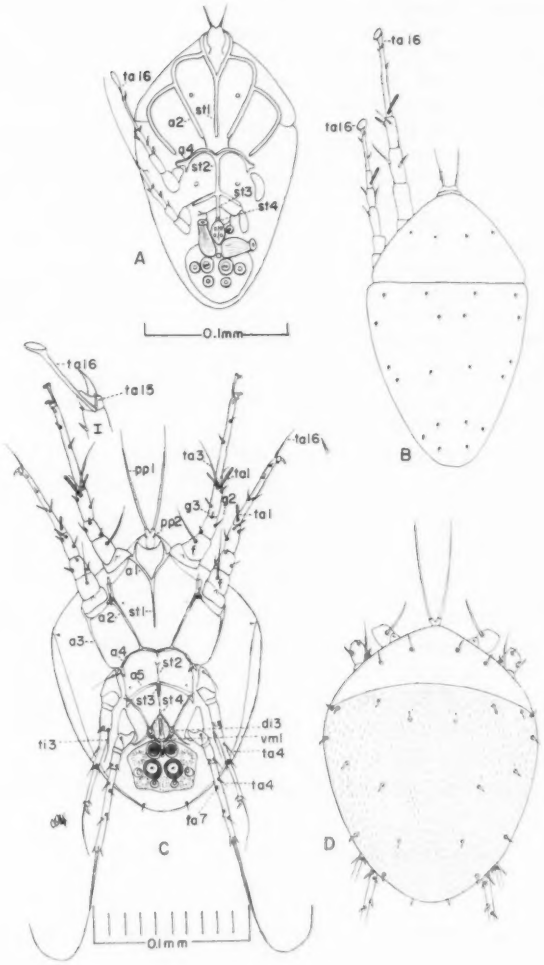

Plate 51 – Upper, *Anoetus alicola* deutonymph. A – venter. B – dorsum. (After Dujardin) Lower, *Anoetus laboratorium* deutonymph. C – venter. D – dorsum.

r1, and *vm3* opposite the anterior end of external genitalia; position of *r2* posterior to sclerotized apodeme *a8*, and leg IV functionless as a walking appendage; for the deutonymph pitted hysterosoma, arrangement of apodemata, shape of suctorial plate, size of disc *di3;* leg IV without claw and with long "end hair," functionless as a walking appendage. Studies show that the life cycle may be completed within five days. The short life cycle plus the fact that the deutonymph appears to be very hardy, can make this species a serious pest in *Drosophila* cultures as well as a frequent contaminant in mite cultures. The haploid number of chromosomes is 4. It is interesting to note that although this species is very hardy and prolific, it has not been observed in the hundreds of collections made by us. It might be surmised that it is not a native of Eastern United States but of some distant area, and that it has been distributed by exchange of *Drosophila* cultures from one laboratory to another. This species is named *"laboratorium"* because of its occurrence in laboratory *Drosophila* cultures. It is arrhenotokous.

Collections. — 1945 *Drosophila* culture obtained from a biological supply house in Chicago, Illinois; 1951 *Drosophila* culture furnished by J. Novikoff, Baltimore, Maryland; 1952 collected in England by A. M. Hughes.

Types. — Holotype and paratypes in U. S. National Museum, Washington, D. C. Paratypes located as follows:

U. S. National Museum, Washington, D. C.
British Museum of Natural History, London, England
Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands
Museum National d'Histoire Naturelle, Paris, France
The South Australian Museum, Adelaide, South Australia
Natal Museum, Peitermaritzburg, Union of South Africa
National Collection, Ottawa, Canada
USSR Academy of Science, Moscow and Leningrad, USSR
Musee Royal d'Histoire Naturelle de Belgique, Brussels, Belgium

Anoetus alicola (Dujardin), 1849

(Plate 51)

Hypopus alicola Dujardin, 1849; *Anoetus alicola* (Dujardin), 1849, [Oudemans, 1924c]; *Anoetus discrepans* Oudemans, 1903.

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 51). Length 0.126-0.248 mm.; color brownish; shape oval, elongate. *Venter.* — Fused pedipalps expanded in mid-region, barely extending beyond propodosoma; breadth almost equal to length; pedipalpal seta *pp1* slightly longer than fused pedipalps. Coxae I and III with small structures assumed to be setae which Oudemans (1903) described as rudimentary sucking discs. Coxa IV with disc *di3*. Sternum *st1* not making contact with apodemata *a4*. Apodeme *a2* faintly continuous with *a4*. Apodemata *a4* continuous in midline. Sternum *st2* continuous with *a4* and *a5*. Sterna *st3* and *st4* continuous. *Dorsum.* — Dorsum smooth; setae minute. *Legs.* — Seta *tal6* I-II spoon-shaped; seta *tal6* leg III more spatulate; leg IV with "end hair" as long as last four joints. Tarsi I-III with minute claws.

Remarks. — Because of the unusually small size of the coxal I and III structures, it is believed that they are actually the bases of minute setae rather than discs or rudimentary suckers as Oudemans suggests. Although the possession of coxal I and III setae and *vm1* located mesiad of disc *di3* are diagnostic characters of the genus *Anoetus*, both are usually minute and often very difficult to observe. Oudemans does not show either type of seta, but on the basis of other general characters, as well as their assumed presence in this instance, we are placing this species in the genus *Anoetus*. Many leg setae are not shown and were probably overlooked. It should be noted that the "end hair" on tarsus IV is probably not *tal6* but rather a highly modified claw as in *A. laboratorium*. We have reproduced Oudemans' figure of *A. discrepans* instead of Dujardin's original drawing. Features most useful in identifying the deutonymph of this species are short fused pedipalps and seta *pp1*, arrangement of apodemata, shape of suctorial plate, minute equal dorsal setae, spoon-shaped *tal6* legs I-II, spatulate *tal6* leg III and long "end hair" leg IV.

Collections. — Collected by Dujardin on wing of bee, from Saint-Gaudens (Haute-Garonne), France, 1849; by Oudemans on *Halictus notatus* K, near Bremen, Germany, 1903.

Types. — In Oudemans' collection (*A. discrepans*).

Anoctus bushlandi, sp. nov.

(Plates 52, 53)

Female. — (Plate 52). Length 0.425 mm.; width 0.260 mm. *Venter.* Chelicera finely and uniformly serrated, with approximately eight teeth; lateral chelicercal flagellum about three times length of toothed region. Pedipalpal seta *pp1* laterally directed, trailing, over five times length of *pp2*. Small thin leaf-like structures project laterally from the labium.

Ringlike structures small; *r1* elliptical and heavily chitinized; *r2* more rounded. Setae small, hairlike. Seta *vo3* twice as long as other ventral setae and about one-half as long as *vo3* of *A. laboratorium*. Seta *do7* marginal. *Dorsum.* — Smooth except for sculptured rostrum. All setae including *dp3* and *dp4* as long or longer than combined length of genu, tibia, and tarsus of leg I, except *dp1* and *dp2*. Position and size of bursa copulatrix similar to that of *A. laboratorium* except not raised from surface of dorsum. *Legs.* — By comparison with *A. laboratorium* trochanter setae *t* leg I-III and femoral seta *f* leg IV much shorter; position and arrangement of other leg setae similar.

Male. — (Plate 52). Length 0.290 mm.; width 0.165 mm. *Venter.* — Gnathosoma as in female. Setae small, hairlike, variable in length. Seta *vm1* posteriad of anterior ringlike structure *r1; r2* opposite apodeme *a8*. *Dorsum.* — As in female, except seta *do7* is missing. *Legs.* — In contrast to *A. laboratorium* tarsus I seta *ta6*, tarsus II *ta6* and *ta7* less robust; trochanter setae *t* legs I-III, and femoral seta *f* leg IV one-half as long.

Deutonymph. — (Plate 53). Length 0.167 mm.; width 0.131 mm. More oval in shape than *A. laboratorium*. *Venter.* — Fused pedipalps similar in size and shape to *A. laboratorium*. Pedipalpal seta *pp1* slightly more than half length of tarsus I. Coxae I, III, IV setae minute as in *A. laboratorium*. Coxa IV disc *di3* small, about one-half diameter of suctorial plate disc *pd2*. Arrangement of apodemata similar to *A. laboratorium*, except sternum *st2* is continuous with apodemata *a4*, and *st3* ends in an inverted "Y" posteriorly. Suctorial plate distinctly indented laterally; central *pd1* almost twice diameter of functional sucker *su*. *Dorsum.* — Finely shagreened, except for anterior membranous margin of propodosoma; setae minute and hairlike. *Legs.* — All legs with claws. By comparison with *A. laboratorium*, seta *ta16* leg I spoon-shaped but smaller; seta *ta15* lancet-shaped and longer; seta *ta16* leg II lancet-like; femoral setae *f* legs I-II one-half as long; tarsal setae *ta4* and *ta7* leg IV much longer. Leg III *ta16* approximately four times length of claw; leg IV *ta16* as least six times as long as claw.

Remarks. — The combination of adult characteristics most useful in identifying this species is as follows: finely serrated chelicera; extremely long *pp1;* small nearly round ringlike structures; uniformly long dorsal seta, except *dp1* and *dp2; dp3* and *dp4* long and equal; for the female *vm3* posterior to *r2*, and small unraised bursa copulatrix on lines between setae *do1* and *do5;* for the male position of setae *vm1* posterior to *r1*, and *vm3* anterio-mesiad of *r2*. The deutonymph characteristics most useful for identification are shagreened dorsum; membranous anterior extension of propodosoma; hairlike dorsal setae; extremely small disc *di3;* laterally indented suctorial plate; large disc *pd1;* arrangement of apodemata; and

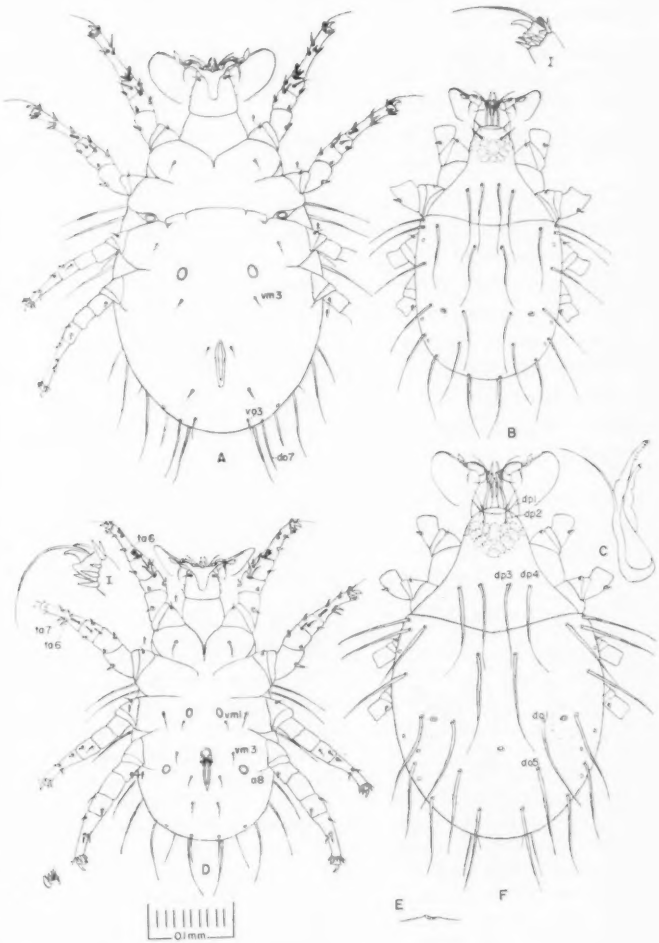

Plate 52 – *Anoetus bushlandi*. A – female, venter. B – male, dorsum. C – chelicera. D – male, venter. E – bursa copulatrix. F – female, dorsum.

length of leg IV *ta16*. The shape of suctorial plate with lateral indentations is unique among all the anoetids so far examined. This species is arrhenotokous. Named in honor of R. C. Bushland.

Collections. – Collected by O. Schomberg, on stable fly media, Kerrville, Texas, November, 1951; by R. C. Bushland, on stable fly media, Kerrville, Texas, April, 1952.

Types. – Holotype and paratypes in U. S. National Museum, Washington, D. C. Paratypes located as follows:

U. S. National Museum, Washington, D. C.
British Museum of Natural History, London, England
Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands
Museum National d'Histoire Naturelle, Paris, France
The South Australian Museum, Adelaide, South Australia
Natal Museum, Peitermaritzburg, Union of South Africa
National Collection, Ottawa, Canada
USSR Academy of Science, Moscow and Leningrad, USSR
Musee Royal d'Histoire Naturelle de Belgique, Brussels, Belgium

Anoetus conclavicola Oudemans, 1929

(Plate 53)

Female. – No information.

Male. – No information.

Deutonymph. – (Plate 53). Length 0.170 mm.; width 0.110 mm. Color yellowish brown. *Venter.* – Fused pedipalps similar to *A. laboratorium* except seta *ppl* is only slightly longer than tibia I, and is blunt at end. Sternum *st1* not making contact with apodemata *a4;* apodeme *a2* making contact with *a4;* apodemata *a4* continuous in midline, and making contact with sternum *st2;* sterna *st2-st4* continuous. Coxa I and III setae minute and club-shaped. Coxa IV seta *vm1* small spine-like, mesiad of disc *di3*. Suctorial plate large and ellipsoid. Disc *pd1* twice diameter of sucker *su*. *Dorsum.* – Indications of faint sculpturing on propodosoma. Setae equal, minute and fine. *Legs.* – Leg I seta *ta16* spoon-shaped, *ta15* large unstalked, palette-shaped, *ta1* nearly one-half length of tarsus I; leg II *ta16* short, club-shaped, seta *ta15* unstalked, palette-shaped; seta *f* legs I-II long as in *A. laboratorium;* leg III *ta16* long, lancet-shaped; seta *ti3* shorter than *A. laboratorium*, seta *ta4* equal in length to *ta16;* leg IV *ta16* longer than leg, seta *ta4* and *ta7* distinctly longer than corresponding setae in *A. laboratorium*.

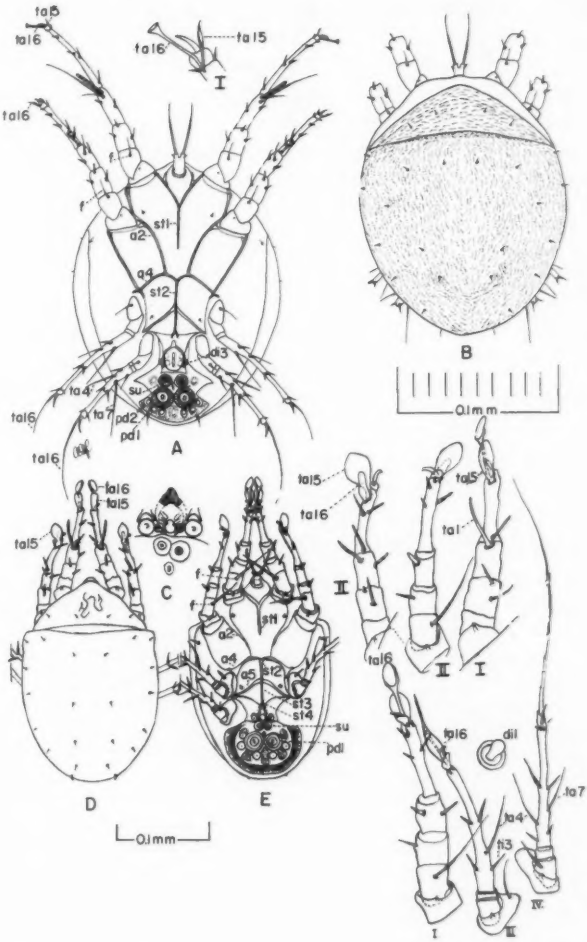

Plate 53 — Upper, *Anoetus bushlandi* deutonymph. A — venter. B — dorsum. Lower, *Anoetus conclavicola* deutonymph. C — discs *di3* and associated area. D — dorsum. E — venter. Right, legs I-IV and seta *di1*. (Original unpublished drawing by A. C. Oudemans)

Remarks. – Blunt pedipalpal setae *pp1* have not been observed in any anoetid studied in detail. Its presence in this species may be due to breakage, or if confirmed would have diagnostic value. The unusual club-shaped setae on coxae I and III are also peculiar to this species. Because of the extreme smallness of these coxal setae in general their exact shape is more often than not open to some doubt (cf. *A. gibsoni*). Generally conspicuous leg setae which are not shown in Oudemans' drawings are as follows: tarsus I setae *ta2* and *ta3;* tarsus III *ta6*. Features most useful in identifying this species are as follows: short fused pedipalps, arrangement of apodemata, minute equal dorsal setae, *ta16* leg I spoon-shaped, *ta16* leg II club-shaped, *ta16* leg III long lancet-shaped, *ta16* leg IV exceptionally long and tapering.

Collections. – Collected by A. Collart on *Koptorthosoma nigrita* Fabr. Stanleyville, Belgian Congo, 1928.

Types. – In Musee du Congo – Belge, Tervueren, Belgium.

Anoetus gibsoni (Nesbitt), 1954, new combination

(Plates 54, 55)

Zwickia gibsoni Nesbitt, 1954.

Female. – (Plate 54). Length 0.435 mm.; width 0.280 mm. *Venter.* – Chelicera finely serrated with approximately twenty-two teeth, diminishing in size distally; cheliceral flagellum nearly twice length of serrated portion. Pedipalpal seta *pp1* directed anteriorly and laterally, over twice length of *pp2*. Seta *pp2* minute, fine, and directed mesially. Ventral setae fine, varying in length. In comparison with *A. laboratorium* seta *vp1* hairlike, three times as long; *vm2* further posteriad of ringlike structure *r1*, hairlike and twice as long; seta *vm3* almost contiguous mesially with ringlike structure *r2*, hairlike and twice as long; *vo1*, *vo2* and *vo3* short, equal in length and more closely grouped around anus; marginal seta *do7* more ventral in position. Ringlike structures ovoid; posterior pair *r2* more widely separated than in *A. laboratorium*. Two mesial pit-like structures located slightly posteriad of vulva. *Dorsum.* – Propodosoma separated from hysterosoma by faint sulcus. Dorsum smooth, except for faintly granular rostrum. Setae generally stout and distinctly variable in length. In comparison with *A. laboratorium* setae *dp3*, *dm1*, *dm2* and *do1* shorter. Dorsal pit-like structures same as for *A. laboratorium* except *dpi3* appears to be missing. Position of bursa copulatrix nearly on line with setae *do5*. *Legs.* – By comparison with *A. laboratorium* all legs are longer. Leg setae in general are outstandingly heavier and longer, less curved and tapering.

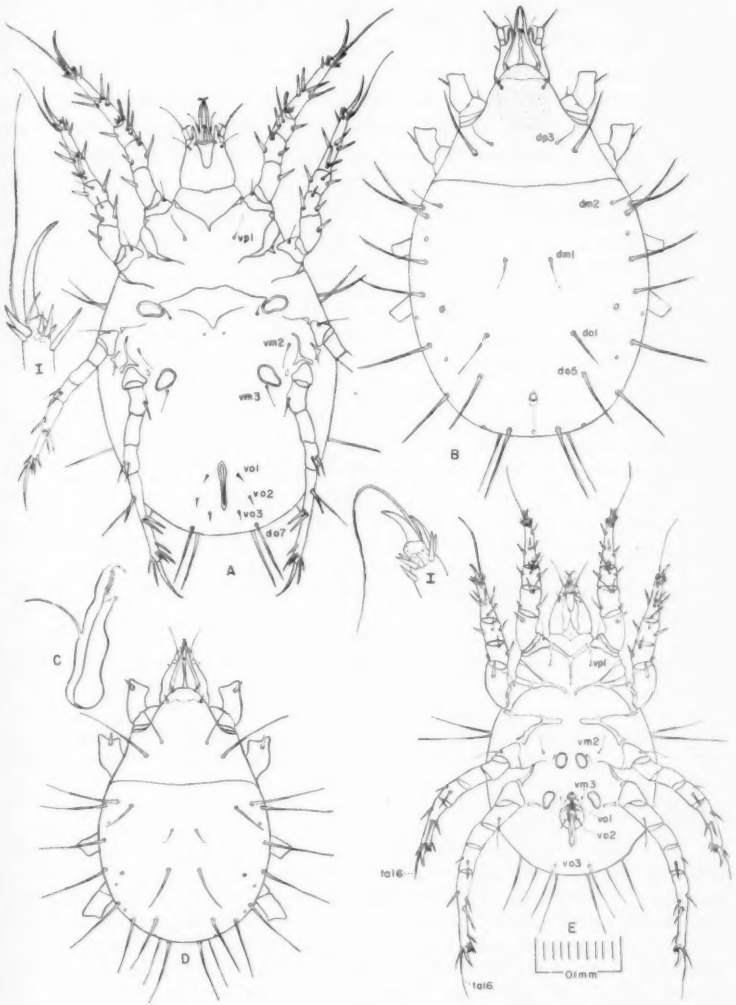

Plate 54 – *Anoetus gibsoni*. A – female, venter. B – female, dorsum. C – chelicera. D – male, dorsum. E – male, venter. (Modified after Nesbitt)

Male. – (Plate 54). Length 0.300 mm.; width 0.200 mm. *Venter.* – Gnathosoma as in female. Pedipalpal seta *pp2* extremely minute or absent (see under remarks). Ventral setae variable in length, and fine except *vo3*. In comparison with *A. laboratorium* seta *vp1* hairlike, almost twice as long; *vm2* almost twice as long and more distant from trochanter III; *vm3* closer to genital apparatus and mesiad of ringlike structure *r2; vo1* and *vo2* borne on genital plate, and anterior to anus; *vo3* twice as long and heavier; anterior ringlike structures *r2* ovoid, closer together and on level with external genitalia; genitalia and a portion of anus associated with a conspicuous genital plate. *Dorsum.* – Smooth, except for faintly sculptured rostrum. Pit-like structures and setae essentially as in female. *Legs.* – setae arrangement similar to female, but setae generally smaller. Outstanding exceptions are as follows: seta *ta16* leg III twice length of claw; *ta16* leg IV over three times length of claw; claws shorter and heavier than in female.

Deutonymph. – (Plate 55). Length 0.259 mm.; width 0.200 mm. Unusually broad in region of opisthosoma. *Venter.* – Fused pedipalps almost three times as long as wide, and extending well beyond propodosoma. Pedipalpal seta *pp1* equal to combined length of genu I and tibia I. Posterior ends of sternum *st1* and apodemata *a2* on a line, and do not meet *a4;* apodemata *a4* extend anteriorly and do not make contact in midline; apodemata *a5* and sternum *st3* extend anteriorly with ends free. Coxae I and III with minute, peg-like setae. Coxae IV and seta *vm1* hairlike, twice length of coxae I and III setae. Suctorial plate ellipsoid, relatively small; functional suckers *su* equal in diameter to central disc *pd1. Dorsum.* – Smooth, except for faint transverse sculpturing on propodosoma. Setae fine, minute, and equal. *Legs.* – Seta *ta16* leg I spoon-shaped; leg II *ta16* lancet-shaped; legs III-IV *ta16* long, tapering. All legs with claws. Setae generally prominent. In comparison with *A. laboratorium* setae *f* leg I-II shorter; setae *ta1* legs I-II much larger; seta *ta4* leg III much longer; seta *f* leg IV shorter; setae *ta4* and *ta7* leg IV much longer. Claws long, slender and slightly curved.

Remarks. – This species is unusual in that in the adult female pedipalpal seta *pp2* is directed mesially. In the male this seta is extremely minute, and is not certainly present, although in one or two specimens it appeared to be present. Nesbitt claims that it is absent. A faint dorsal sulcus can be seen in both male and female. Nesbitt does not describe a sulcus for either male or female, nor does he show one in his figure. The presence of a pair of pit-like structures posteriad of the vulva is unique except for *Z. quentheri* in comparison with all other anoetids we have studied in detail. These pit-like structures are somewhat smaller than the dorsal pit-like structures and for this reason may not be comparable.

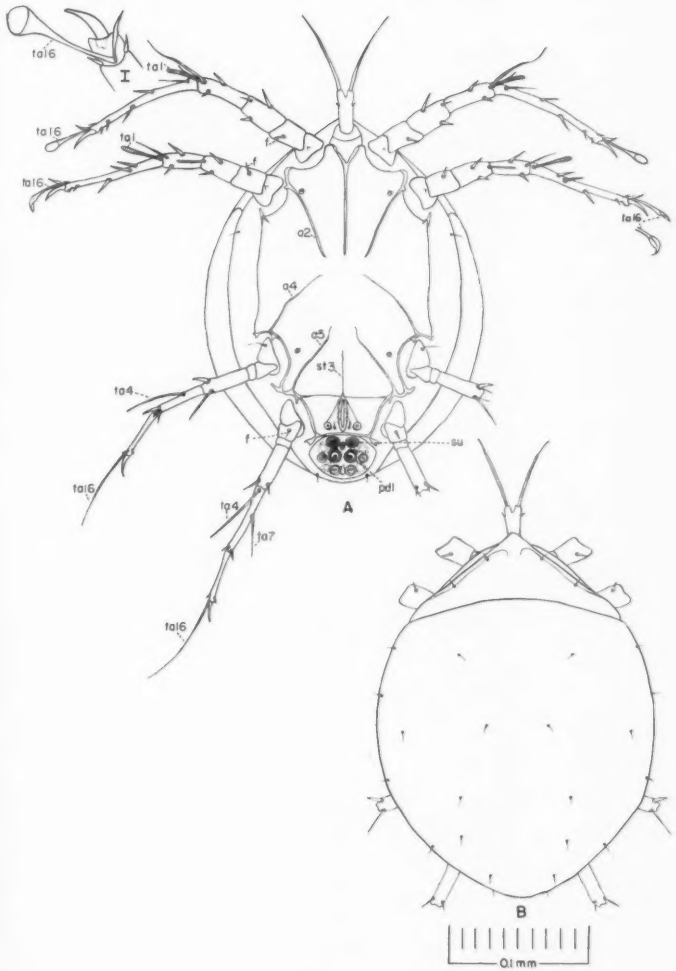

Plate 55 — *Anoetus gibsoni* deutonmyph. A — venter. B — dorsum. (Modified after Nesbitt)

The bursa copulatrix is much more posterior in position than for *A. laboratorium* and *A. bushlandi*. The leg setae of this species are unusually stout and clear, and are useful in confirming the setal pattern for other species in which there is some doubt about the presence of a few minute setae. The claws of the female are unusually long and almost spine-like in shape. We have placed this species in the genus *Anoetus* because it shows all the necessary diagnostic features including a faint dorsal sulcus in the adult, although it must be admitted that it also has many features at present considered to be characteristic of other species of the genus *Zwickia*. Among such features may be mentioned: the arrangement of the anal setae of female, the unusually long claws of the adults, the small suctorial plate, and arrangement of apodemata in the deutonymph. Specimens for study were kindly furnished by Dr. Nesbitt.

Collections. — Collected by H. H. J. Nesbitt in pitchers of *Sarracenia purpurea* L. from sphagnum bogs at Glengarne (Danford Lake, Aylwin Township, Gatineau County, Quebec).

Types. — In Nesbitt's collection.

Anoetus heliocopridis Vitzthum, 1926

(Plate 56)

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 56). Length 0.157 mm.-0.169 mm.; width 0.099 mm.-0.104 mm. Color pale yellow. *Venter.* — Fused pedipalps equal length of tibia I, extending about one-half length beyond propodosoma. Seta *pp1* equal length of tarsus II. Sternum *st1*, and apodemata *a2* and *a3* make contact with apodemata *a4;* apodemata *a4* continuous in midline; sternum *st2* faintly continuous with apodemata *a4* and continuous with *a5;* sternum *st3* makes contact with apodemata *a5*, but is not in contact with *st4*. Coxae I and III with minute setae; coxa IV wtih fine seta, mesiad of small discs *di3*. Suctorial plate ellipsoidal. *Dorsum.* — Hysterosoma finely honey-combed anteriorly and more longitudinally striated posteriorly; propodosoma smooth. Dorsal setae short and fine. *Legs.* — Tarsal setae *ta16* legs I-II lancet-shaped with definite midrib; *ta16* leg III tapered, almost three times length of claw; *ta16* leg IV tapered, over four times length of claw; seta *ta3* leg I longer than tarsus. In comparison with *A. laboratorium* the following differences are noted: leg I *f* spine-like, about one-third as long; leg II seta *f* about one-half as long.

Remarks. — The description above is based primarily on Oudemans'

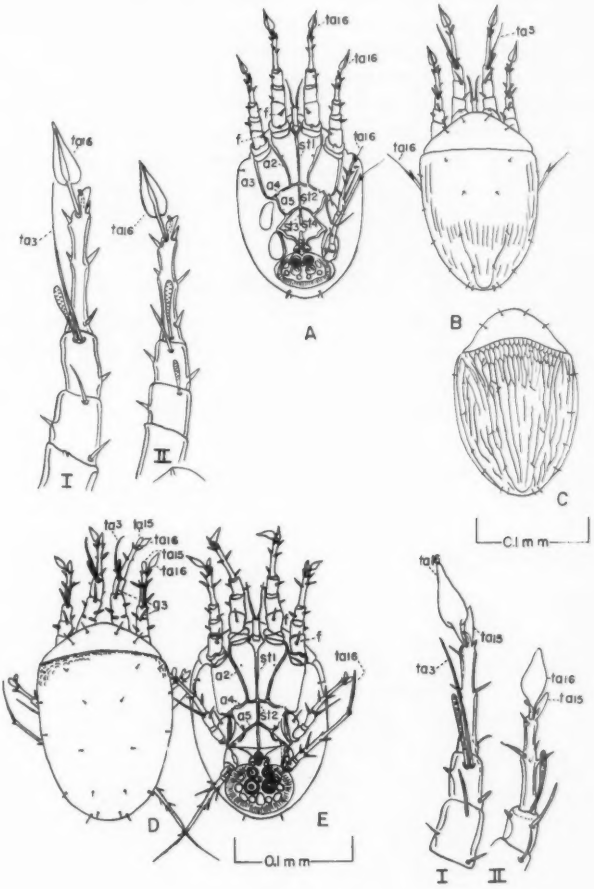

Plate 56 — Upper, *Anoetus heliocopridis* deutonymph. Left, legs I-II. A — venter. B — dorsum. C — dorsum of another specimen in which striations were more definite. (Original unpublished drawing by A. C. Oudemans) Lower, *Anoetus turcastanae* deutonymph. D — dorsum. E — venter. Right, legs I-II. (Original unpublished drawing by A. C. Oudemans)

(1916) original drawings and to a lesser degree on Vitzthum's (1926b) description of this species. Vitzthum's drawings differ from Oudemans' in one or two possibly important respects, as follows: Vitzthum does not show a sculptured hysterosoma, and his drawing of the suctorial plate is almost round instead of ellipsoidal. If these differences are accurately shown it is possible that they were dealing with closely related, but different species. It may be noted that Oudemans does not show all of the leg setae typical for anoetids. It is assumed that the missing setae were overlooked. Features most useful in identifying this species are as follows: length of fused pedipalps and setae *pp1*, arrangement of apodemata, hysterosoma longitudinally striated, dorsal setae short and fine, *ta16* legs I-II lancet-shaped, *ta16* legs III-IV tapering.

Collections. — Collected by H. J. Veth on *Heliocopris bucephalus.* Fabricus, February 20, 1903, in Java; by Paravicini near Lembang, Java, July, 1921.

Types. — In Oudemans' collection in Arnhem.

Anoctus nepenthesiana (Hirst), 1928, new combination

(Plate 57)

Zwickia nepenthesiana Hirst, 1928.

Female. — (No figure). Length 0.370 mm. *Venter.* — Ringlike structures larger and more elongated than in male; position of these structures apparently typical for female anoetids. Terminal posterior setae shorter than in the male. *Legs.* — The legs and leg setae are weaker than in the male; claw of leg I longer and more slender.

Male. — (Plate 57). Length 0.340 mm.; width 0.225 mm. *Venter.* — Pedipalpal setae *pp1* and *pp2* apparently minute. Details of gnathosoma not clear from Hirst's description. Propodosomal seta *vp1* equal to genu I; metapodosomal seta *vm1* less than one-half length of *vp1*, lateral to and almost contiguous with anterior ringlike structure *r1*; *vm2* slightly longer than *vp1*, and on coxa III; *vm3* equal to *vm1*, and mesiad of posterior ringlike structure *r2*; *vo2* longer than *vm2*, and posterior to anus; *vo3* nearly equal length of leg III. Ringlike structures ellipsoid; structures *r1* close together and nearly on a line between trochanters III; structures *r2* more widely spaced and on a line between trochanters IV. *Dorsum.* — (No figure). Dorsum smooth; setae fine, much shorter than exceptionally long *vo3*. *Legs.* — All legs with strong spines. Tarsi II-III with terminal group of stout spines. Claw I short and stout, claws II-IV long, slender and slightly curved; claw IV shorter than II and III.

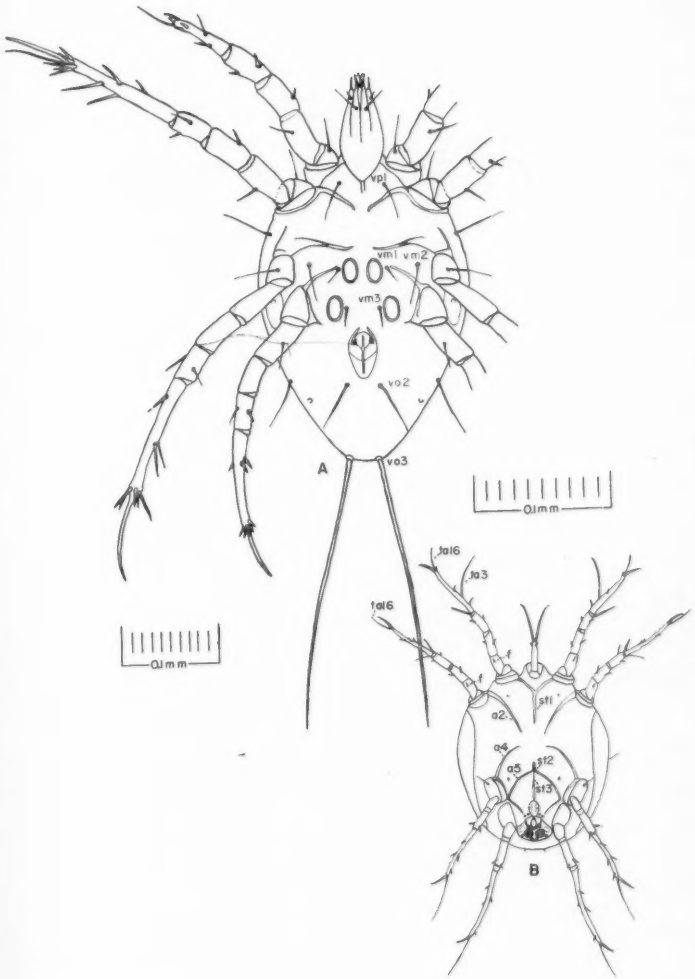

Plate 57 — *Anoetus nepenthesiana*. A — male, venter. B — deutonymph, venter. (After Vitzthum)

Deutonymph. — (Plate 57). Length 0.210 mm.; width 0.100 mm. *Venter.* — Fused pedipalps long, slender and extending well beyond propodosoma; pedipalpal setae *pp1* longer than fused pedipalps. Sternum *st1*, and apodemata *a2* and *a4* free in mid-region; apodemata *a5* join in midline to form a short sternum *st2*, which is continuous with *st3*. Coxa I with minute structure, assumed to be seta; coxa III with minute seta. Coxa IV with minute seta mesiad of the extremely small disc *di3*. Suctorial plate almost triangular in shape, with four extremely small posterior discs. *Dorsum.* — No information. *Legs.* — All legs with long, slender and slightly curved claws. Terminal tarsal setae *ta16* all legs long, tapering. Setae *f* legs I-II short. Seta *ta3* leg I as long as tarsus.

Remarks. — In Hirst's drawing of the venter of the male, a pair of opisthosomatic pit-like structures are shown laterad of seta *vo2*. No such structures have been seen in this position on the venter of the males of other anoetids. However, they would fit the position of other species if they were dorsal instead of ventral. That Hirst is showing both dorsal and ventral structures is indicated by the fact that he shows the excretory pores in the same drawing. Many leg setae apparently have been overlooked. Hirst's drawing definitely is that of the male, as his description also indicates, but was labeled in error a female. Vitzthum when republishing this figure omitted the genitalia, and called it a tritonymph, presumably because of the position of the ringlike structures which is more characteristic of the tritonymph than the female. Hirst's drawing of the deutonymph clearly shows coxa III with minute seta. Coxa I, however, is shown without a definite seta, but merely a dot which could represent either a minute disc, or seta. Vitzthum's modification of Hirst's drawing represents the structure on coxa I as a minute disc, and coxa III with a minute seta, and calls attention to this observation in the text. If Vitzthum's observations are correct a new genus would have to be established. In view of Vitzthum's uncertainty as to whether or not the structure on coxa I is truly a disc, and also in view of the difficulty of observing coxal setae in other species, the view is taken here that coxa I has a seta rather than a disc. Thus the presence of setae on coxae I and III instead of discs, and the position of seta *vm1* mesiad of disc *di3* places this species in the genus *Anoetus* instead of *Zwickia*. Hirst's drawing of the deutonymph shows apodemata *a5* not continuous in midline. Vitzthum on closer examination of the apodemata states that *a5* are actually continuous in midline. This point of view is accepted here. Since both Vitzthum and Hirst have overlooked many leg setae, it is possible that the details of setae *ta16* legs I-II may not be accurately represented. It is more likely that they are spoon-shaped, or lancet-like, as in most anoetids, rather than tapering. It is of interest that *A. nepenthesiana* and *A. gibsoni* have a number of characteristics in common with *Z. guentheri*, such as long slightly curved claws and in the migrant a small suctorial

plate and free apodemata.

Collections. – Found by Mr. C. Boden Kloss and Mr. Cedric Dover in the pitchers of *Nepenthes ampullaria,* in the jungle around Thompson Road Reservoir, Singapore. It appears that Vitzthum (1931) examined specimens of this species which were not the same as Hirst's original material, but the source is not given. Collected by investigators in *Nepenthes gymnamphora* pitchers in Sumatra and Java in 1931.

Types. – No record.

Anoetus polynesiacus Vitzthum, 1920

(Plate 58)

Female. – No information.

Male. – No information.

Deutonymph.–(Plate 58). Length 0.155 mm.; width 0.097 mm. Shape nearly oval, with pointed end posteriorly. Color pale yellow. *Venter.* – Fused pedipalps less than one-half length of tarsus II, wider at base, and not extending to end of propodosoma. Pedipalpal seta *ppl* equal to length of tarsus II. Apodemata *a1* short, joining anteriorly to form sternum *st1*. Sterna *st1*, *st2* and apodemata *a2* unite with apodemata *a4*, which latter are continuous in midline. Sternum *st2* with faint wing-like lateral extensions; *st2* and *st3* are continuous, and united with apodemata *a5*. Coxae I and III with minute structures, assumed to be setae. Coxa IV with large and distinct disc *di3*. Suctorial plate ellipsoid. The four posterior and lateral plate discs *pd2* and *pd3* equal in size to sucker *su*. *Dorsum.* – Dorsum smooth; setae hairlike, and varying in length. Lateral propodosoma seta *dp4* about one-third length of median pair *dp3* which is longer than tibia I; all hysterosomal setae longer than median propodosomal setae *dp3* except setae *do5* which is equal in length to *dp3*, and *do4* and *do6* which are equal in length to *dp4*. *Legs.* – Tarsal setae *ta16* legs I-II spoon-shaped. Setae *ta16* legs III-IV comparatively short and tapering. Seta *ta3* leg I nearly equal to tarsus I. All legs with small but distinct claws.

Remarks. – Vitzthum states that the minute structures on coxae I and III appear to be faintly developed suckers, but that this is not at all certain. The position is taken here, as in *A. alicola*, that these structures are actually the bases of minute setae. It seems likely that these setae as well as the small setae *vm1* mesiad of the discs *di3*, were overlooked by Vitzthum, since they are difficult to observe in other species of genus *Anoetus*, and since such minute discs without setae have not been ob-

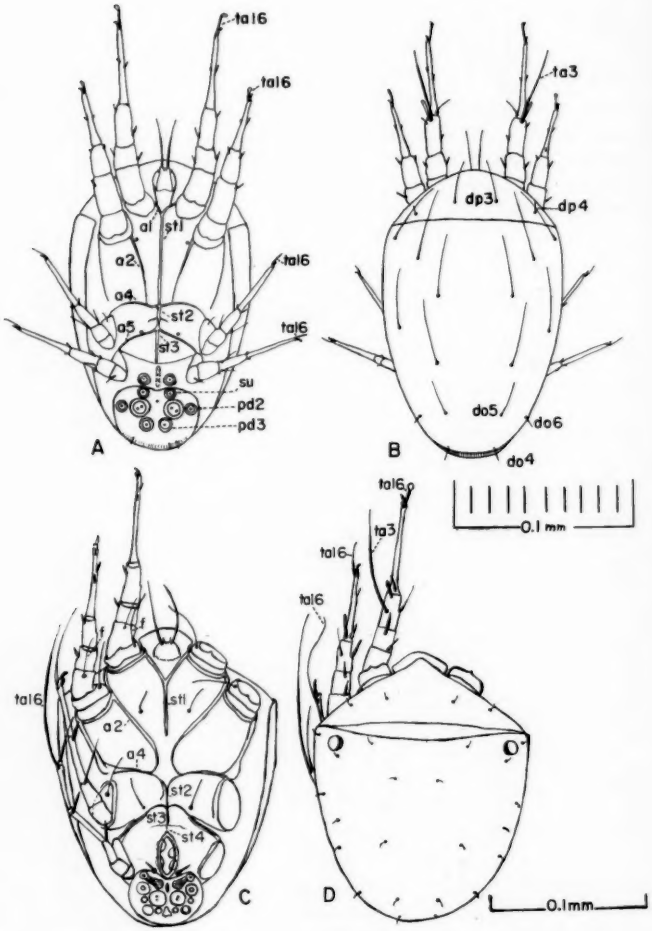

Plate 58 – Upper, *Anoetus polynesiacus* deutonymph. A – venter. B – dorsum. (After Vitzthum) Lower, *Bonomoia primitiva* deutonymph. C – venter. D – dorsum. (Original unpublished drawing by A. C. Oudemans)

served with certainty in any anoetids. On the basis of the usual setae pattern for the deutonymph, setae *dm5* and *do3* were apparently overlooked by Vitzthum. It also appears that Vitzthum missed a number of leg setae. Features most useful in identifying this species are as follows: short fused pedipalps, arrangement of apodemata, dorsal setae hairlike and varying in length, *ta16* legs I-II spoon-shaped, *ta16* legs III-IV short and tapering.

Collections. — Discovered by Vitzthum on the beetle *Eubactrus semiaeneus* Lacord. Supplied by R. Kleine from Fiji Islands.

Types. — In Vitzthum's collection.

Anoetus turcastanae Oudemans, 1917

(Plate 56)

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 56). Length 0.165 mm.; width 0.110 mm. *Venter.* — Fused pedipalps approximately equal to genu I, barely extending beyond propodosoma; pedipalpal seta *pp1* equal to tarsus I. Sterna *st1*, *st2* and apodemata *a2* unite with apodemata *a4*, which latter are continuous in midline. Sterna *st2* and *st3* continuous and united with apodemata *a5*; *st3* and *st4* appear to be faintly continuous. Coxae I and III with faint structures which are assumed to be minute setae; coxa IV with disc *di3*. Suctorial plate large, ellipsoid. *Dorsum.* — Dorsum smooth except for faintly shagreened anterior portion of the hysterosoma. Hysterosomal setae minute and equal, about one-third of the length of propodosomal setae. *Legs.* — Tarsal seta *ta16* legs I-II lancet-like; seta *ta15* lancet-like but shorter and more blunt. Tarsus III bears a pair of membranous structures assumed to correspond to *ta16*, and an extension of claw base. Seta *ta16* leg IV long and tapering, equal to pedipalpal seta *pp1*. Seta *f* legs I-II about half length of *A. laboratorium;* seta *g3* legs I-II more than twice length. Seta *ta3* leg I longer than tarsus I. All legs with small claws.

Remarks. — Apparently Oudemans overlooked seta *vm1*, which for this genus should be mesiad of disc *di3*. Oudemans has missed only a few leg setae. The terminal tarsal membranous structures of leg III are worthy of note since such structures appear to be unique among the anoetids. Features most useful in identifying this species are as follows: length of fused pedipalps and seta *pp1*, arrangement of apodemata, shagreened anterior hysterosoma, *ta16* legs I-II lancet-shaped, leg III with a pair of membranous structures terminally, and *ta16* leg IV long and tapering.

Collections. — Found on *Homalocopris tmolus* Fisch. by H. J. Veth, in Turkestan, February, 1903.

Types. — No record.

GENUS *Bonomoia* Oudemans, 1911

Diagnosis of genus. — Diagnosis is based on deutonymph. Coxa I and III with prominent hairlike seta; suctorial plate with two functional suckers, two large central discs, and four small marginal discs. One pair of translucent cuticular elevations, giving the appearance of "eyes" located on the anterio-lateral margins of the dorsal hysterosoma.

Type. — *Bonomoia primitiva* Oudemans, 1911.

Bonomoia primitiva Oudemans, 1911

(Plate 58)

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 58). Length 0.187 mm.; width 0.140 mm. *Venter.* — Fused pedipalps equal to genu I; pedipalpal seta *ppl* two-thirds length of tarsus I. Sternum *st1* free posteriorly; apodeme *a2* S-shaped, curved posteriorly to join *a4; a4* curve posteriorly in midline to join *st2*. Venter described as pitted, but not shown in figure. *Dorsum.* — Dorsum pitted, with "eyes" as described for genus; setae minute, hairlike, and equal. Pedipalpal base extends anteriorly beyond propodosoma. Pitted dorsum described but not shown in figure. *Legs.* — Seta *tal6* leg I small spoon-shaped; *tal6* leg II tapering; *tal6* leg III tapering and longer than *ppl; tal6* leg IV tapering and longer than entire leg IV. The seta presumed to be *ta3* leg I arises from tibia and is longer than tarsus I. Claw III longer and heavier than claws I-II. Claw IV elongated. Femoral setae *f* legs I-II are long and hairlike, nearly as long as *ppl*.

Remarks. — Features most useful in identifying this species other than those diagnostic for the genus are as follows: short, wide, fused pedipalps; arrangement of apodemata; absence of coxal IV disc *di3;* pitted venter and dorsum; short equal dorsal setae; shape of *tal6* all legs; leg IV claw long and tapering; seta *ta3* leg I longer than tarsus. Named in honor of G. Cos. Bonomo.

Collections. — One specimen on a blattid with hard abdomen, collected by D. MacGillavry in Banjoewangi, Java, 1910.

Types. — Holotype in Oudemans' collection.

GENUS *Chiropteranoetus* Womersley, 1942

Diagnosis of genus. — Diagnosis is based on the deutonymph. Coxa I with strong, blunt seta, no disc; coxa III without disc, or seta. Coxa IV with short, blunt, spine-like process, and a fine seta *vm1* mesiad of this process. Suctorial plate with two functional suckers *su;* two large central discs *pd1;* and four spine-like processes in positions corresponding to discs *pd2* and *pd3*.

Type. — *Chiropteranoetus chalinolobus* Womersley, 1942.

Chiropteranoetus chalinolobus Womersley, 1942

(Plate 59)

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 59). Length 0.300 mm.; width 0.195 mm. *Venter.* — Fused pedipalps longer than tibia I. Pedipalpal seta *pp1* approximately equal to tibia I; *pp2* nearly one-half as long as *pp1*. Suctorial plate small, almost round. Other characteristics as for genus. It should be noted that in Womersley's figure, the seta presumed to be coxa III seta is actually trochanter III seta *t* and is characteristic for this segment. If his figure is correct coxa III is without a seta or disc. *Dorsum.* — Dorsum smooth; setae hairlike, slightly variable in length. Seta *dp4* almost twice as long as dp3. *Legs.* — All tarsi with small claws, except tarsus IV, which has two terminal setae shorter than tarsus IV, a unique feature if correctly observed by Womersley.

Remarks. — Apodemata not shown. Structures which appear to represent small functional suckers *su* are shown by Womersley, but not described. Of interest is the similarity of the suctorial plate spines of this species and *Myianoetus undulatus*. Womersley describes, probably in error, six propodosomal setae instead of the usual four as for other anoetids. Many leg setae typical of this family are not shown by Womersley. Features useful in identifying this species are: long fused pedipalps, length of *pp1* and *pp2*, stout coxae I and IV setae, presence of suctorial plate setae, and dorsal setae hairlike and varying in length.

Collections. — A single specimen from residue in jar containing bats, *Chalinolobus gouldi*, probably from South Australia.

Types. — Probably in Museum in Adelaide, Australia.

GENUS *Glyphanoetus* Oudemans, 1929

Diagnosis of genus. – Diagnosis is based on the deutonymph. Coxa I without disc or seta; coxa III with disc *di2;* coxa IV with small seta *vm1* mesiad of disc *di3;* suctorial plate with two functional suckers, two large central discs, and four discs laterally and posteriorly.

Type. – *Glyphanoetus horridum* (Berlese), 1913.

Glyphanoetus horridum (Berlese), 1913, new combination

(Plates 60, 61)

Histiostoma horridum Berlese, 1913; *Glyphanoetus fulmeki* Oudemans, 1929.

Female. – (Plate 60). Length 0.250 mm.; width 0.160 mm. *Venter.*

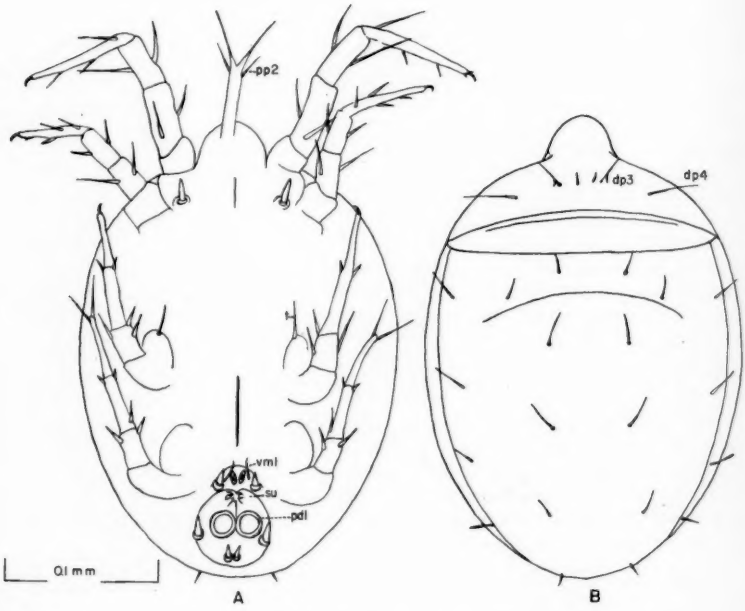

Plate 59 – *Chiropteranoetus chalinolobus* deutonymph. A – venter. B – dorsum. (After Womersley)

– Chelicera not serrated, distally enlarged, cup-shaped; cheliceral flagellum equal to seta *dm3*. Seta *pp1* over three times as long as *pp2*. Membrane associated with pedipalps prominent, projecting laterally and anteriorly. Ringlike structure *r1* smaller and more mesiad than *H. julorum*, *r2* nearly oval and lies close to anterior end of anus. Setae hairlike, variable in length. Seta *vm1* conspicuous. Definite anal plate bearing posterior ringlike structures and opisthosomatic setae. Seta *do7* on ventral surface posterior to anal plate. Without ventral pit-like structures *vpi1*. *Dorsum*. – Finely granular; rostrum faintly sculptured. Six pairs of unusually long, saber-shaped setae, borne on distinct bosses; other setae smaller, varying in length. Excretory pores on raised boss-like structures. Bursa copulatrix on level with excretory pores, boss-like and directed anteriorly. Without dorsal pit-like structures. *Legs*. – Leg setae similar to *H. julorum*. A most unusual feature is the extremely long saber-like seta *ti3* leg I. All legs slender; claw bases pointed, especially legs II-IV.

Male. – (Plate 60). Length 0.167 mm.; width 0.100 mm. *Venter*. – Gnathosoma same as female. Genital plate present with small ringlike structure *r1* on level with anterior margin, and *r2* on level with anterior end of anus and widely separated. Type of setae similar to female except more variable in size. Two pairs of fine setae-like genital spicules. Seta *do4* marginal instead of dorsal. Seta *dm3* anterior to *r2*. *Dorsum*. – Dorsum heavily sculptured. Setae *dm1*, *do1*, and *do5* reduced in comparison with female. Bosses conspicuous. No pit-like structures observed. *Legs*. – As in female except *ta1* leg II longer, finer than *ta1* leg I.

Deutonymph. – (Plate 61). Length 0.132 mm.; width 0.100 mm. *Venter*. – Fused pedipalps equal to tibia I. Seta *pp1* equal to tarsus II. Apodemata *a2* unite with *a4;* sternum *st1* free posteriorly, *st2* free anteriorly, and continuous with united apodemata *a5* and *st3* posteriorly. Other features as for genus. *Dorsum*. – Propodosoma faintly sculptured transversely. Anterior margin of hysterosoma striated, otherwise smooth. Propodosomal setae short, fine; hysterosomal setae variable in length, generally long, slender and flexible; *do4* and *do6* short. *Legs*. – Seta *ta16* leg II tapering, not spoon-shaped; *ta16* leg III-IV short.

Remarks. – Seta *ta3* leg I longer than tarsus II. Male small as compared with female; one of the most completely sculptured anoetids observed. Good slides of this species are difficult to prepare because of the extremely long saber-shaped setae. The non-serrated chelicerae are atypical. Vitzthum was shown *G. horridum* by Grandjean. This specimen was from Spain. Berlese saw only the female, and Oudemans only the deutonymph. Oudemans' deutonymph was described as having fine points on the hysterosoma and ten pairs of long setae instead of eight. These observations could not be confirmed. Features useful in identifying the adult of this species are non-serrated chelicera, length of pedipalpal se-

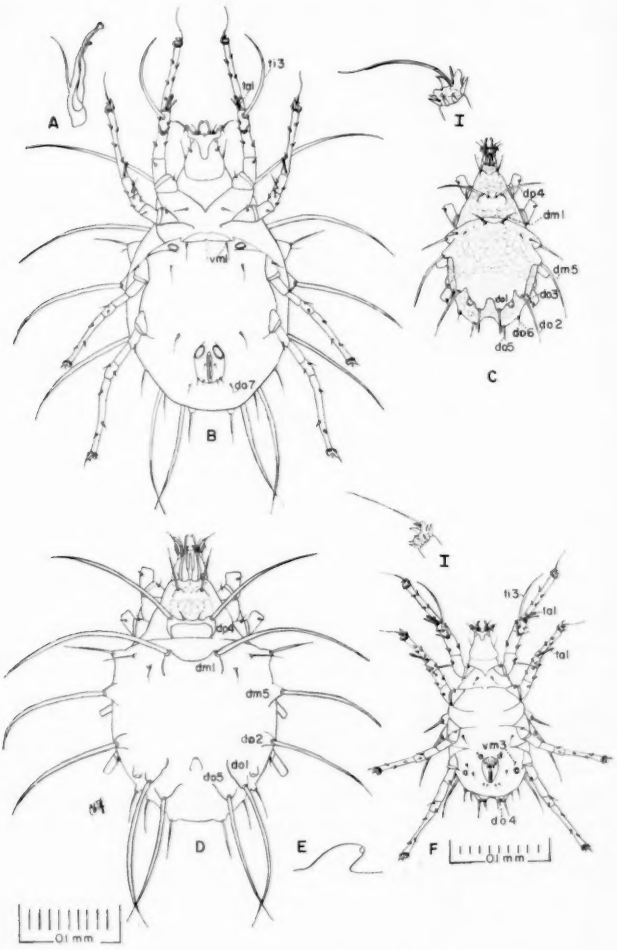

Plate 60 – *Glyphanoetus horridum*. A – chelicera. B – female, venter. C – male, dorsum. D – female, dorsum. E – bursa copulatrix. F – male, venter.

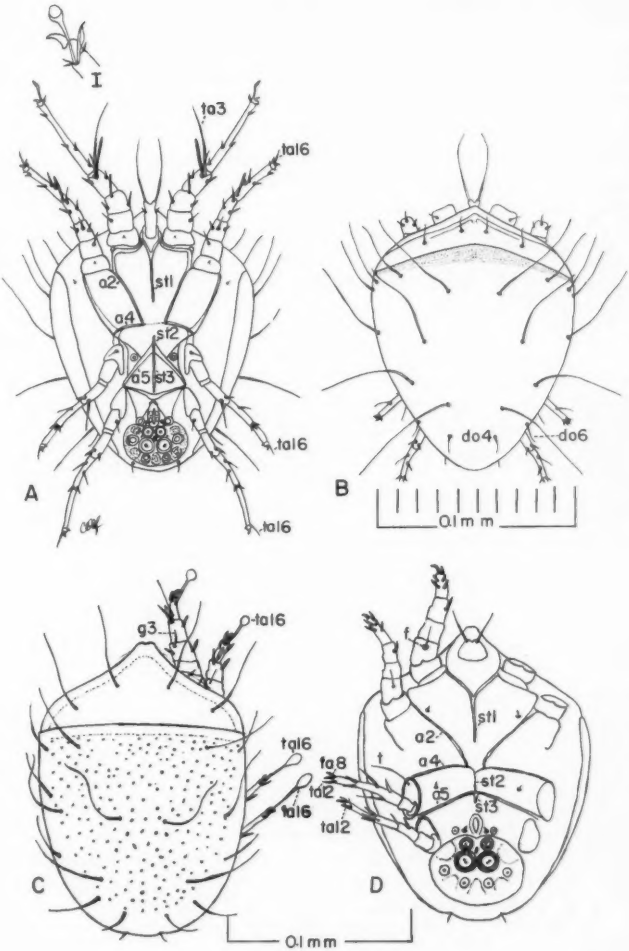

Plate 61 — Upper, *Glyphanoetus horridum*, deutonymph. A — venter. B — dorsum. Lower, *Lipstorpia mixta* deutonymph. C — dorsum. D — venter. (Original unpublished drawing by A. C. Oudemans)

tae, membranous structures associated with pedipalp, position of ringlike structures, saber-shaped setae borne on prominent bosses, claw bases extended and tapering above claw, and leg III *ti3* extremely long and heavy; for the deutonymph, length of fused pedipalps and seta *pp1*, arrangement of apodemata, long, hairlike dorsal setae, and shape of leg setae *ta16*.

Collections. — Collected by Jacobson in Java, 1913; by L. Fulmek in a vineyard near Weenen, Germany, 1929; by A. H. O'Bier at mouth of Cone River near Warsaw, Virginia, 1953.

Types. — Holotypes, no record. Plesiotypes (supplied by present authors) in U. S. National Museum, Washington, D. C. Plesiotypes in authors' collection.

GENUS *Lipstorpia* Oudemans, 1911

Diagnosis of genus. — Diagnosis based on deutonymph. Coxa I and III with small seta; coxa IV with small seta median to disc *di3*. Suctorial plate with two functional suckers, two large central discs, and four small discs. Legs I-IV with spoon-shaped terminal setae *ta16*.

Type. — *Lipstorpia mixta* Oudemans, 1911

Lipstorpia mixta Oudemans, 1911

(Plate 61)

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 61). Length 0.166 mm.; width 0.118 mm. *Venter.* — Gnathosoma expanded; fused pedipalps broad at base, tapering anteriorly, width at base greater than length; pedipalpal seta *pp1* twice length of fused pedipalps. Sternum *st1* free posteriorly; apodeme *a2* faintly continuous with *a4;* apodemata *a4* slightly arched, continuous in mid-line and joining *st2;* apodemata *a5* continuous in midline and joining with *st2* and *st3*. Coxa I and III with small, thorn-shaped setae, coxa IV with small setae median to discs *di3*. *Dorsum.* — Propodosoma smooth, hysterosoma pitted. Setae hairlike and flexible; propodosomal setae equal to leg III less coxa; hysterosomal setae variable in length, generally long. *Legs.* — Tarsi I-II short, equal to tibia. By comparison with *H. julorum* the following setae differences are noted: leg I seta *f* longer, g3 longer, mid-tarsal setae more closely grouped; leg II *ta16* spoon-shaped, mid-tarsal setae more closely grouped; leg III seta *t* long-

er, *ta8* and *ta12* equal length of claw, *ta16* spoon-shaped; leg IV *ta8* and *ta12* equal to claw, *ta16* spoon-shaped.

Remarks. — The combination of features most useful in identifying the deutonymph of this species is as follows: short laterally expanded fused pedipalps, length of *pp1*, arrangement of apodemata, coxa I, III, and IV with small setae; dorsally pitted hysterosoma, long dorsal setae; spoon-shaped terminal tarsal setae all legs, and extremely short tarsi legs I-II, a feature which Oudemans considers diagnostic for this genus. A number of leg setae are omitted or missing in comparison with *H. julorum*. Oudemans in 1914c placed *H. brevimanus* and *H. crassipes* in the genus *Lipstorpia* and in 1917 these were placed under genus *Anoetus*.

Collections. — Two specimens collected by D. MacGillavry on a blattid with hard abdomen, Banjoewangi, Java, 1910.

Types. — Probably in Oudemans' collection.

GENUS *Mauduytia* Oudemans, 1929

Diagnosis of genus. — Diagnosis based on deutonymph. Coxa I and III without discs or setae; coxa IV with small seta *vm1* mesiad of disc *di3*. Suctorial plate with two functional suckers, two large central discs and four discs laterally and posteriorly.

Type. — *Mauduytia tropicus* (Oudemans), 1911

Mauduytia tropicus (Oudemans), 1911

(Plate 62)

Anoetus tropicus Oudemans, 1911; *Mauduytia tropicus* (Oudemans), 1911 [Oudemans, 1929].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 62). Length 0.156 mm.; width 0.110 mm. *Venter.* — Width of fused pedipalps one-half of length, length one-half of tarsus II; pedipalpal seta *pp1* longer than tarsus I. Sternum *st1* free posteriorly; apodeme *a2* united with *a4;* apodemata *a4* continuous in midline and united with *st2;* apodemata *a5* continuous in midline and united with *st2* and *st3; st3* divided; *st4* not shown. Suctorial plate functional suckers *su*, discs *pd2*, and *pd3* equal to coxal disc *di3*. *Dorsum.* — Smooth. Gnathosomal base extended anteriorly beyond propodosoma. Propodosoma

nearly rectangular, less than one-eighth length of entire soma. Setae minute, hairlike and equal in length. *Legs.* – Leg shape and setae arrangement similar to *H. julorum* except: setae *ta16* legs I-II lancet-shaped with definite midrib, leg III *ta16* short, and *ta16* leg IV equal in length to tibia and tarsus of leg IV; leg I setae *f* and *g3* longer, *ta3* longer than tarsus I; leg II *ti2* longer; leg III *ta4* short. A few typical leg setae are not shown in Oudemans' drawing.

Remarks. – In view of the difficulty of observing coxal setae I and III in some species of the genus *Anoetus* it is possible that these structures may have been overlooked. If such setae are discovered in future studies, then this species would fall into genus *Anoetus*. The extreme length of terminal tarsal seta *ta16*, leg IV is typical of most of the *Anoetus* species. Features most useful in identifying this species are as follows: length of pedipalpal setae, arrangement of apodemata, smooth dorsum, short, almost rectangular propodosoma, minute and equal dorsal setae, long *ta3* leg I, lancet-shaped setae *ta16* legs I-II, and extremely long *ta16* leg IV.

Collections. – One specimen collected by D. MacGillavry on a blattid with hard abdomen, Banjoewangi, Java, 1910.

Types. – No record.

GENUS *Myianoetus* Oudemans, 1929

Diagnosis of genus. – Diagnosis is based on the deutonymph. Suctorial plate with two functional suckers and two large discs. Claws of leg I-III cleft.

Type. – *Myianoetus muscarum* (Linnaeus), 1758.

Remarks. – Of the *Myianoetus* species so far described *M. filicum*, *M. muscarum*, *M. diadematus* are without coxal I and III discs or setae, *M. undulatus* has either vestigial discs or minute setae on coxa I and III, and *M. setipes* has minute coxal I and III setae. Only *M. filicum* has a conspicuous coxa IV disc. In addition to the functional suckers and large discs on the suctorial plate *M. undulatus* bears four thorn-like structures, *M. diadematus* two setae, *M. muscarum* two spine-like structures, and according to Tradgardh *M. setipes* bears four thorn-like structures. Hence, the common diagnostic features for this genus are those listed above.

Myianoetus undulatus, sp. nov.

(Plates 62, 63)

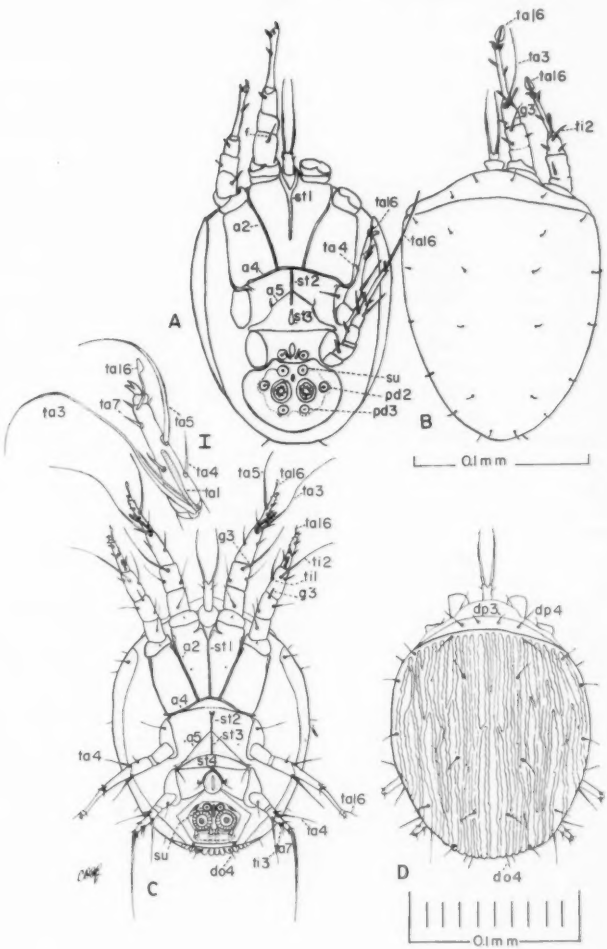

Plate 62 — Upper, *Mauduytia tropicus* deutonymph. A — venter. B — dorsum. (Original unpublished drawing by A. C. Oudemans) Lower, *Myianoetus undulatus* sp. nov. deutonymph. C — venter. D — dorsum.

Female. – (Plate 63). Length 0.380 mm.; width 0.280 mm. *Venter.* – Chelicera not serrated, tapering distally; median member of chelicera forked; cheliceral flagellum equal to typical dorsal metapodosomal seta. Pedipalp unusually long, surrounded by conspicuous membranous structure extending beyond distal end of pedipalp; *pp1* twice length of chelicercal flagellum, three times length of *pp2* which latter arises from subterminal position. Ringlike structures *r1* nearly round, and lying near midline. Genital opening inverted V-shape, with distinct supporting structure in midline easily mistaken for a longitudinal opening. Ringlike structures *r2* nearly round, larger than *r1*, close together just above anus. Setae number is one greater than in other anoetids, generally equal in length, and differing in position from *H. julorum* as follows: *vm1* anteriomesiad of *r1*, *vo1* laterad of *r2*, *vo3* close to posterior end of anus, *do7* ventral instead of dorsal. Correspondence of ventral setae to setae of other forms is made on the basis of relative position; the extra seta *vo-x* is then assumed to be the one posteriad to *r2*. An anal plate is faintly visible. *Dorsum.* – Smooth except for finely granular rostrum. Propodosomal seta *dp1*, *dp2*, and *dp3* one-half or less length of typical metapodosomal setae; *dp4* slightly more separated than *dp3*, two-thirds length of typical metapodosomal setae; all metapodosomal setae approximately equal except for the unusual large, brush-like setae *dm1*, *do1*, and *do5*; bases of setae *dm1* are contiguous. Bursa copulatrix terminal with opening posteriorly. *Legs.* – All legs generally longer than *H. julorum;* tarsi especially longer. Setae number and arrangement typical, differing from *H. julorum* as follows: leg I seta *t* shorter, *f* finer, *ti2* longer, *ta1* larger, *ta15* long, tapering, almost equal to *ta16;* base of *ta2* separated from *ta1*, leg II seta *t* shorter, *f* finer, *ti2* with rounded end; leg III seta *t* shorter. Membranous claw base legs II-IV distinctly expanded and tapering.

Male. – (Plate 63). Length 0.240 mm.; width 0.140 mm. *Venter.* – Gnathosoma as in female. Ringlike structures *r1* nearly round, close together anteriad of genitalia; *r2* oval, more separated than *r1*, anteriolaterad of genitalia. Setae hairlike, approximately two-thirds length of tibia II except *vm3* which is equal to tibia II, and setae presumed to be *vo1* and *vo2* shorter. Relative position of setae as in *H. julorum* except for more anteriorly placed opisthosomatic setae, *do4* ventral instead of dorsal and *do6* marginal. Setae *vo1* and *vo2* are observed with some uncertainty along with two pairs of tiny genital spicules, closely associated with the genitalia. Penial seta apparently normally directed anteriorly. Anus and external genitalia surrounded by faint genital plate. Two faint atypical sclerotized patches posteriad of *r1*. If the above assumptions are correct relative to identity of setae, the male has the typical number of setae. *Dorsum.* – Smooth except for very faintly granular dorsum. Setae approximately two-thirds length of tibia II, except for *dp1*, *dp2*,

and *dp3* which are shorter. Setae *dp4* only slightly more separated than *dp3*. *Legs.* — Legs long and slender with especially long tarsi including legs I-II which in most male anoetids are shorter and more massive than legs III-IV. Setae similar in position to *H. julorum*, generally smaller with following differences: leg I *ti2* larger, and is striated as macro-sense organ *ta1*; *ta1* and *ta2* arise independently slightly distal to the tibio-tarsal joint; mid-tarsal setae more separated, *ta15* longer than *ta16*, and straight with rounded end; leg II *ti2* with rounded end and striated, *ta1* larger, mid-tarsal setae more separated. Membranous claw base legs II-IV as in female.

Deutonymph. — (Plate 62). Length 0.150 mm.; width 0.115 mm. *Venter.* — Fused pedipalps equal to tibia II; pedipalpal seta *pp1* nearly twice as long as fused pedipalps; sternum *st1*, and apodemata *a2* and *a3* continuous posteriorly with *a4* which latter are united in midline; membranous portion of *a4* faintly continuous in midline; *st2* Y-shaped anteriorly, posteriorly continuous with *st3*; *st4* short. Coxa I-III with extremely minute setae or possibly vestigial discs and are seen with difficulty; coxa IV with hairlike seta *vm1* mesiad of small sclerotized structure reminiscent of vestigial disc. Suctorial plate hexagonal, with two functional suckers *su*, two large central discs, and four relatively large setae posteriorly. *Dorsum.* — Propodosoma smooth and short with membranous anterior extension covering gnathosomal base and part of femurs I-II; hysterosoma distinctly longitudinally sculptured. Seta *dp4* nearly twice as long as *dp3* and slightly longer than hysterosomal setae; hysterosomal setae hairlike, nearly equal. Posterior opisthosoma tucked under to place seta *do4* in a ventral position. *Legs.* — Tarsi I-II and tibia and tarsus IV conspicuously shortened; arrangement of setae similar to *H. julorum*, with following differences: setae of leg I femur and genu longer and finer, especially *g3* which is longer than *pp1*; tibia setae more hairlike, *ta3* twice length of *pp1*, *ta5* longer than *pp1*, *ta16* small, spoon-shaped; leg II femur and genu setae longer and finer except for *g3*, *ti2* longer than *pp1*, *ta16* small lancet-shaped; leg III similar except for shorter *ta16*; leg IV *ti3* longer, *ta7* shorter; tarsus with long tapering terminal seta, claws I-III cleft.

Remarks. — Features useful in identifying this species for the adult are: conspicuous membranous structures associated with pedipalp, *pp2* arising nearly from center of pedipalp, smooth except for finely granular rostrum, membranous claw base expanded and tapering above claw, propodosomal setae *dp4* slightly longer and only slightly more separated than *dp3*; for the female, inverted V-shaped genitalia, terminal bursa copulatrix, more mesially placed ringlike structures *r1*, *r2* close together above anus, extra ventral opisthosomatic setae close to anus, peculiar brush-end setae *dm1*, *do1*, and *do5*, long tapering tarsus I seta *ta15*; for the male, ringlike structures above genitalia, opisthosomatic setae associa-

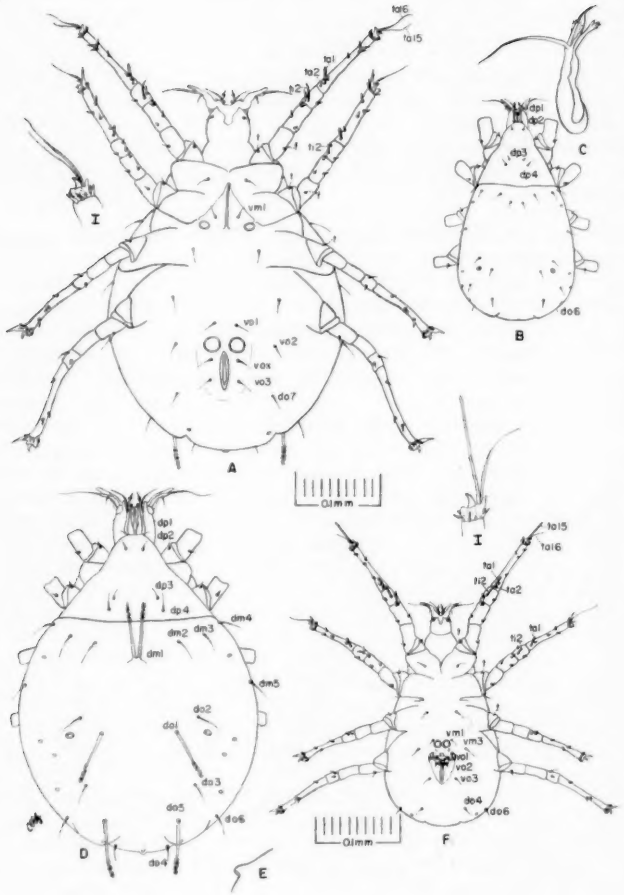

Plate 63 – *Myianoetus undulatus* sp. nov. A – female, venter. B – male, dorsum. C – chelicera. D – female, dorsum. E – bursa copulatrix. F – male, venter.

ted with genitalia difficult to observe, dorsal setae short hairlike, tarsus seta *tal5* leg I straight with rounded end, longer than *tal6*, *ti2* leg I-II atypically striated, similar to macro-sense organ *tal;* for the deutonymph, arrangement of apodemata, extremely small setae or discs on coxa I and III, suctorial plate with two functional suckers *su*, two large central discs, and four strong posterior setae; unique crenulated dorsal hysterosoma; short tarsi I-II and tibia and tarsus IV, unusually long setae *ta3* and *ta5* leg I and *ti2* leg II, claws I-III cleft, leg IV with long tapering terminal seta probably representing a modified claw. Name chosen because of wave-like appearance of the dorsal hysterosoma of the deutonymph.

Collections. — Collected by R. D. Hughes in Chickahominy Swamp, near Ellerson, Virginia, August, 1953.

Types. — Holotype and paratypes in U. S. National Museum, Washington, D. C. Paratypes in authors' collection.

Myianoetus diadematus Willmann, 1937

(Plate 64)

Female. — (Plate 64). Length 0.500 mm.; width 0.270 mm. *Venter.* — Entire venter similar to *M. undulatus* including gnathosomal structure, setae, and position of ringlike structures. Differences as follows: anterior ringlike structures *r1* slightly larger and more separated, *r2* slightly smaller. Willmann's figure shows an extra seta near the posterior end of the longitudinal genital structure, which is presumed to be an error since thickenings of chitin have been observed in this area on *M. undulatus.* Also Willmann shows an extra seta *vo-x* laterad of anus which corresponds to *vo-x* in *M. undulatus. Dorsum.* — Smooth with conspicuous posterior boss-like structures. Except for *do4* which is ventral, setae similar in position to *M. undulatus* but shorter and spine-like. *Legs.* — All legs long and slender; tarsi especially long: leg I similar to *M. undulatus* except for shorter *tal5;* other legs similar. Willmann does not mention an expanded claw base. This may have been present and overlooked.

Male. — (Plate 64). Length 0.450 mm.; width 0.240 mm. *Venter.* — Gnathosoma as in female; setae similar in arrangement to *M. undulatus* but generally more spine-like; ringlike structures similar in position and somewhat smaller; genitalia similar. *Dorsum.* — Very similar to the female. *Legs.* — All legs long and slender as in *M. undulatus,* apparently setae similar in position; *tal5* not shown as being longer than *tal6.*

Deutonymph. — (Plate 64). Length 0.168 mm.; width 0.125 mm. *Venter.* — Fused pedipalps equal in length to genu II; pedipalpal seta *pp1* twice length of fused pedipalps; *pp2* less than one-third length of

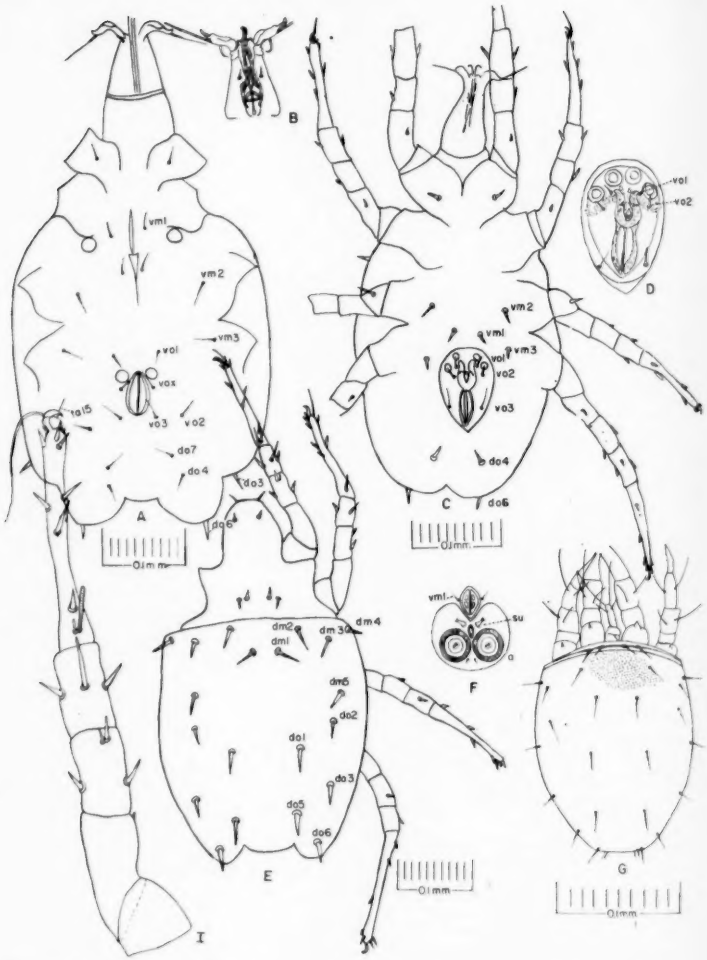

Plate 64 – *Myianoetus diadematus*. A – female, venter. B – gnathosoma. C – male, venter. D – male, genital plate. Lower left – female leg I. E – female, dorsum. F – deutonymph, suctorial plate. G – deutonymph, dorsum. (After Willmann)

pp1. Arrangement of apodemata apparently similar to *M. muscarum* and *M. digitiferous;* suctorial plate with two small suckers *su* and two large discs. Coxa IV with distinct hairlike seta *vm1*. *Dorsum*. — Propodosoma short; hysterosoma coarsely granular; setae hairlike, nearly equal to genu II, although somewhat variable in length. An extra seta is illustrated on Willmann's drawing as compared with *M. undulatus*. This is probably in error. *Legs*. — Willmann's only comment was that leg IV also has a long terminal seta.

Remarks. — This species is strikingly similar to *M. undulatus* with the following exceptions: for the adult, dorsal setae spine-like, *ta15* leg I shorter; for the female, seta *do4* in a ventral position, ringlike structures *r1* larger, *r2* smaller; for the male, ringlike structures smaller, ventral setae more spine-like; for the deutonymph, propodosoma shorter, hysterosoma heavily granular. This species was so named because of the fancied similarity of the propodosoma to a diadem. It should be recognized that the length of the propodosoma varies within the same species according to how specimens are mounted on the slide. Willmann was uncertain whether the adults described were *Myianoetus* sp. or *Histiostoma* sp. In view of the striking similarities between this species and other *Myianoetus sp.* for both the adult and deutonymph forms, it is certain that Willmann has correctly associated the adults and deutonymph in this instance. This observation is further supported by the fact that both the adults and deutonymphs were found in the same niche.

Collections. — Collected by C. Willmann from Segeberger Cave (deutonymph attached to cave insects) Holstein, Germany, 1935.

Types. — No record.

Myianoetus filicum (Dujardin), 1849

(Plate 65)

Hypopus filicum Dujardin, 1849; *Myianoetus filicum* (Dujardin), 1849 [Oudemans, 1937].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 65). Length 0.165 mm.; width 0.112 mm. *Venter*. — Fused pedipalps one-half length of tarsus II; pedipalpal seta *pp1* equal length of fused pedipalps; anterior portion of propodosoma extended well beyond gnathosomal base. Sternum *st1*, apodemata *a2* and *a3* continuous with apodemata *a4* which latter are united in midline; *st2* united with *a4* and *st1* anteriorly and apodemata *a5* posteriorly;

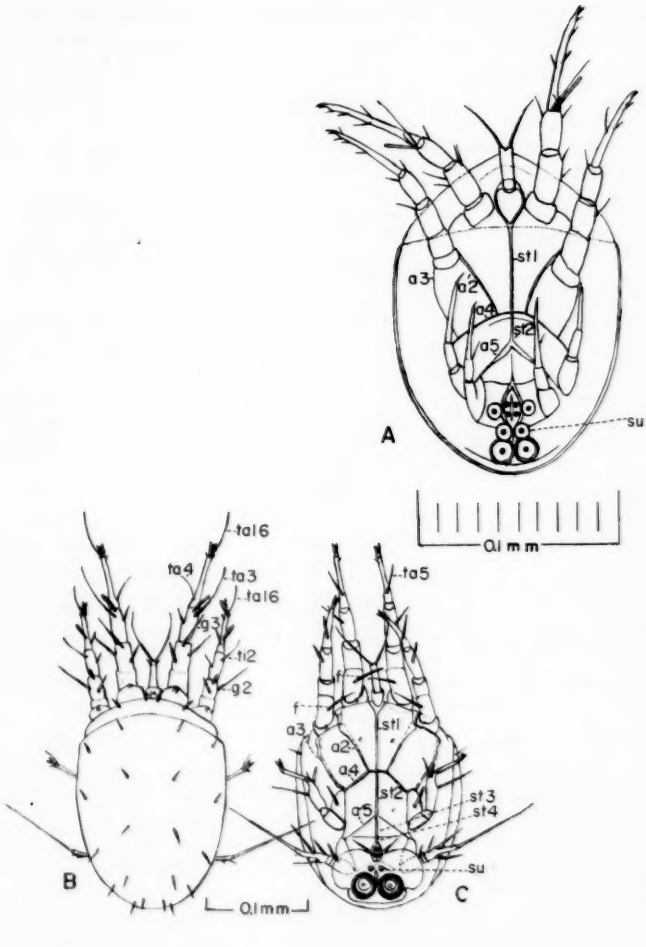

Plate 65 – Upper, *Myianoetus filicum* deutonymph. A – venter. (After Dujardin) Lower, *Myianoetus setipes* deutonymph. B – dorsum. C – venter. (Original unpublished drawing by A. C. Oudemans)

a5 joined in midline. Coxae I and III apparently without discs or setae; coxa IV with disc equal to functional sucker *su* of suctorial plate. Suctorial plate with two functional suckers, and two large discs. *Dorsum.* — No information. *Legs.* — Legs I-II long and slender, tarsi I-II nearly twice as long as *M. undulatus;* legs III-IV considerably shorter and finer than I-II, setae arrangement probably similar to *M. undulatus;* claws I-III cleft.

Remarks. — The combination of characteristics placing this species in the genus *Myianoetus* are cleft claws legs I-III, arrangement of apodemata, and presence of two functional suckers and two large discs on suctorial plate. The well formed discs on coxa IV have not been observed in other *Myianoetus* species. In 1924c Oudemans erroneously identified *Hypopus filicum* as *H. sapromyzarum.* In 1937 he renamed this species *Myianoetus filicum.*

Collections. — Collected by Dujardin on fern *Ceterach officinarum,* September, 1848.

Types. — No record.

Myianoetus muscarum (Linnaeus), 1758

(Plates 66, 67)

Acarus muscarum Linnaeus, 1758 [deGeer, 1735]; *Pediculus muscae* (Linnaeus), 1758 [Gronovius, 1760]; *Trombidium muscarum* (Linnaeus), 1758 [Muller, 1776]; *Hypopus muscarum* (Linnaeus), 1758 [Duges, 1834] *Tyroglyphus muscarum* (Linnaeus), 1758 [Gervais, 1844]; *Gamasus muscorum* (Linnaeus), 1758, [Fabricius, 1822]; *Anoetus muscarum* (Linnaeus), 1758 [Oudemans, 1929]; *Histiostoma muscarum* (Linnaeus), 1758 [Berlese, 1881]; *Myianoetus muscarum* (Linnaeus), 1758 [Oudemans, 1929].

Female. — (Plate 66). Length 0.485 mm.; width 0.250 mm. *Venter.* — Chelicera with three equal teeth; distinct membranous structures associated with pedipalp; pedipalpal seta *pp1* equal to tibia I, three times length of *pp2.* Apodemata *a1* not continuous in midline to form sternum. Ringlike structures *r1* similar in position, slightly larger than *M. undulatus; r2* contiguous with anterio-lateral portion of anus. Transverse genital slit supported by distinct longitudinal structure mistaken for genital slit by Cooreman (1947). Propodosomal seta *vp1* equal to tibia II; other ventral setae somewhat shorter, slightly variable in length. Comparison of ventral setae with *M. undulatus* is as follows: *vm1* posterio-mesiad of *r1, vo1* more anterior, *vo2* contiguous with lateral border of *r2,* an extra seta *vo-x,* typical for this genus posterior to *r2; vo3* very close to posterior margin of anus, *do7* lateral and closer to

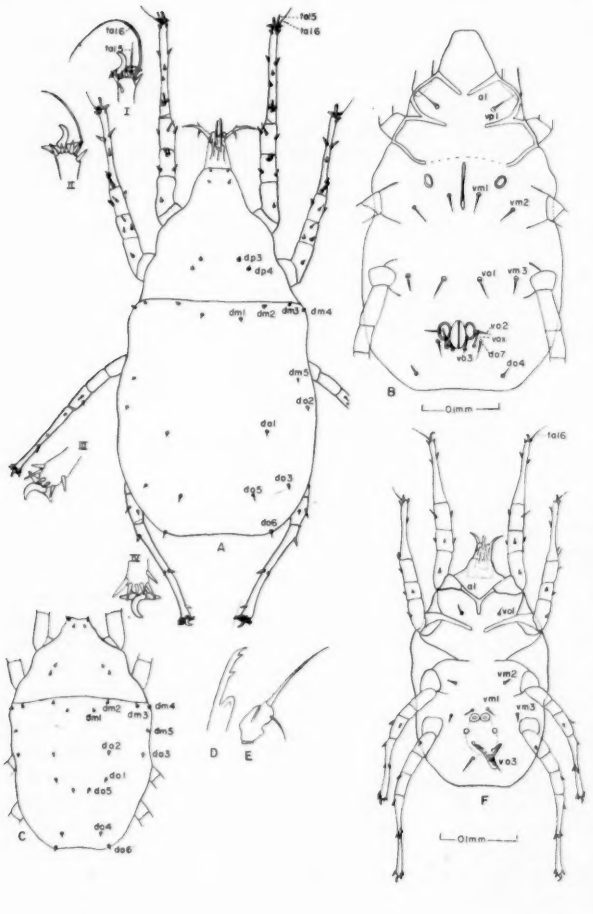

Plate 66 – *Myianoetus muscarum*. A – female, dorsum. Left – distal tarsi I-IV. B – female, venter. C – male, dorsum. D – chelicera. E – pedipalp. F – male, dorsum. (After Cooreman, except chelicera and pedipalp after Berlese)

posterior end of anus, *do4* ventral in position. *Dorsum.* — Dorsum with scattered pores and elevated surfaces which are more evident in living specimens (not shown in figure). All setae short and very fine, equal in length, difficult to observe; seta *do4* ventral. Excretory pores, pit-like structures, and bursa copulatrix neither described, or shown by Cooreman. *Legs.* — In comparison with *M. undulatus*, length and slenderness of legs similar; except omission of setae *t* legs I-III and seta *f* leg IV, setae size and arrangement differing only slightly from *M. undulatus; tal5* leg I less than one-half length of *tal6*. Claws slightly larger than *M. undulatus* and with expanded membranous claw bases.

Male. — (Plate 66). Length 0.300 mm.; width 0.180 mm. *Venter.* — Gnathosoma as in female. Apodemata *a1* continuous in midline forming a short sternum. Ringlike structures *r1* close together above external genitalia; *r1* laterad to posterior portion of genitalia. Comparison of setae with *M. undulatus* as follows: *vm2*, *vm3* shorter, *vo1*, *vo2* not observed, *vo3* longer. *Dorsum.* — Setae minute, equal, and difficult to observe, arrangement varying slightly from *M. undulatus*. No pit-like structures or excretory pores illustrated or described. *Legs.* — Shape similar to *M. undulatus; ta15* not longer than *ta16* leg I, no expanded claw bases shown in figure.

Deutonymph. — (Plate 67). Length 0.245 mm.; width 0.165 mm. *Venter.* — Fused pedipalps equal to tibia II; pedipalpal seta *pp1* over twice length of fused pedipalps; *pp2* less than one-half length of genu I. Apodemata *a2* divided posteriorly, with median portion joining base of *st1*, and with lateral portion free, *a4* continuous in midline; *st2* free anteriorly, posteriorly united with *a5* and *st3; st3* faintly joined to *st4*. Coxae I-III without discs or setae; coxa IV with hairlike seta, without disc. Suctorial plate with two functional suckers *su* and 2 large discs; a pair of faint structures posterior to plate discs resemble setae, but lie below surface. *Dorsum.* — Propodosoma smooth, very short; anterior membranous portion extends anteriorly to partially cover gnathosomal base and trochanters I-II; hysterosoma pitted and finely granular. Propodosomal setae spine-like, one-half length of genu I, nearly equal. Hysterosomal setae short, extremely fine and equal. *Legs.* — Leg shape and proportions of joints similar to *M. undulatus* except for relatively longer tarsus IV; setae generally similar, differences as follows: leg I setae *g3*, *ti1* shorter, *ta2* shorter and displaced to middle of tibia, *ta3* close to *ta2*, *ta5* much shorter, *tal6* long and tapering; leg II *g2* much longer, *ti1* shorter, *ti2* shorter, *tal6* long and tapering; leg III seta shorter; leg IV *ta4* shorter, terminal tarsal seta over twice as long as tibia and tarsus. Claws I-III characteristic for genus.

Remarks. — The combination of adult characteristics useful in identifying this species is as follows: chelicera with three equal teeth, con-

spicuous membranous structure associated with pedipalp, short fine dorsal setae, long slender legs, leg I seta *tal5* shorter than *tal6;* for the female, position of ringlike structures *r1* and *r2*, position of opisthosomatic setae *do4* and *do7* ventral instead of dorsal, presence of *vo-x*, dorsum with scattered pores, expanded membranous claw bases; for the male, short sternum, and ringlike structures above anus; for the deutonymph, long *pp1*, *pp2* arising nearly from center of fused pedipalps, arrangement of apodemata, no discs or setae on coxa I and III, coxa IV with seta and without disc, *tal6* legs I-II tapering distally, leg I *ta3* extremely long and displaced to center of tibia, leg II *g2* very long; leg IV with long tarsal seta, which is probably a modified claw. Linnaeus in 1758 adopted de Geer's description (1735) of this deutonymph and called it *Acarus muscarum*, the specific name after the stable fly *Musca stabulans.* Oudemans in 1929 placed this species in the newly erected genus *Myianoetus.* The adult was first described by Berlese in 1881. Cooreman's adult figures are used; deutonymph figures are from specimens supplied to present authors by W. W. Judd.

Collections. — Collected by de Geer on housefly, Paris, 1735; by Goeze on *Musca fenestralis*, Germany, 1779; by M. Dujardin on *Musca stabulans*, Paris, 1846; by Curtis on domestic fly, 1838; by A. Berlese on *Musca stabulans*, 1881, and on *Cyrtoneura stabulans*, 1886; by G. Canestrini on decaying material with *Cyrtoneura stabulans*, 1888; by Kramer and Canestrini on decayed vegetative material, Europe, 1899; by J. Cooreman on Diptera, 1947; by W. W. Sampson on houseflies, Berkeley, California, October, 1950; by M. T. James on *Calliphora terrae-novae*, Pullman, Washington, April, 1951; by B. Sugerman on *Synthesiomyia nudiseta*, San Juan, Puerto Rico, May, 1953; by W. W. Judd on *Muscina stabulans*, London and Ontario, Canada, June and September, 1953. From the references given by Oudemans (1937) it may be assumed that numerous additional collections were made prior to that date.

Types. — Holotype no record. Plesiotypes supplied by W. W. Judd in U. S. National Museum, Washington, D. C.

Myianoetus setipes (Koch), 1847, new combination

(Plate 65)

Hypopus setipes Koch, 1847; *Anoetus setipes* (Koch), 1847 [Oudemans, 1924c]; *Histiostoma digitifera* Tragardh, 1904; *Anoetus digitiferus* (Tragardh), 1904 [Oudemans, 1929]; *Myianoetus digitiferus* (Tradgardh), 1904 [Oudemans, 1929]; *Anoetus dionychus* Oudemans, 1910; *Myianoetus dionychus* (Oudemans), 1910 [Oudemans, 1929].

Female. — No information.

Male. — No information.

Deutonymph. — (Plate 65). Length 0.220 mm.; width 0.150 mm. *Venter.* — Fused pedipalps equal to tibia II; pedipalpal seta *pp1* nearly twice length of fused pedipalps; *pp2* very short, close to distal end. Coxae I and III with minute setae; coxa IV with seta, without discs; suctorial plate with two functional suckers *su* and two large discs. Sterna *st1* and *st2* and apodemata *a2* and *a3* continuous with *a4*, which latter are united in midline; *st2* and *st3* continuous with united apodemata *a5*; *st3* and *st4* apparently joined. *Dorsum.* — Smooth. Propodosoma short, barely covering gnathosomal base and trochanters I-II. Setae spine-like and one-half length of tibia II, typical in arrangement. *Legs.* — Shape generally similar to *M. undulatus* except for longer tarsi

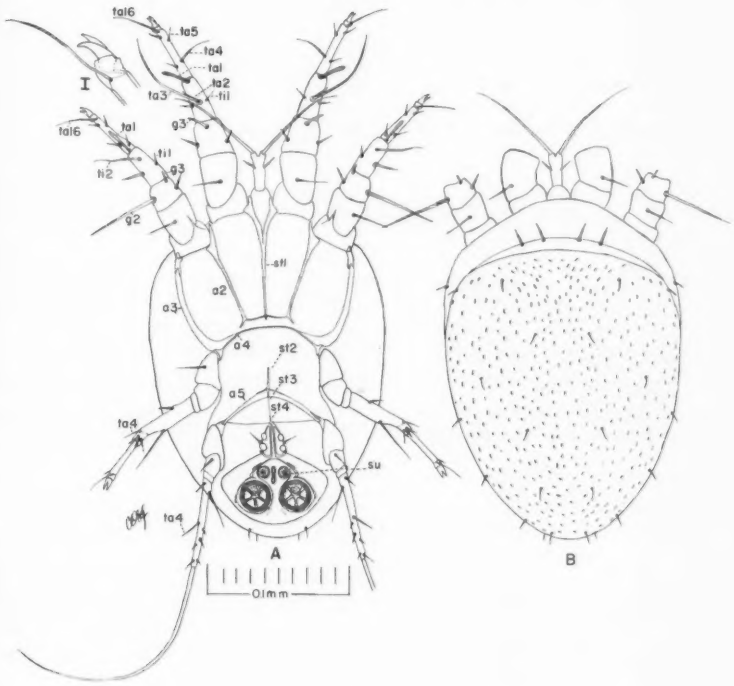

Plate 67 — *Myianoetus muscarum* deutonymph. A — venter. B — dorsum.

I-II; setae differences as follows: leg I seta *f* longer, *g3* shorter and equal to tibia I, *ta3* base slightly separated from *ta1* and equal to tarsus I, *ta4* longer, *ta5* shorter, *ta16* longer and tapering; Leg II seta *f* longer, *g2* longer, *ti2* shorter, two longer mid-tarsal setae, *ta16* long and tapering; proportion and setae arrangement very similar for legs III-IV. The full complement of leg setae is not shown in Oudemans' drawing.

Remarks. – Features most useful in identifying this species are as follows: size of soma, length of pedipalps, length and position of pedipalpal setae, arrangement of apodemata, minute coxa I and III setae, coxa IV without disc but with seta, smooth dorsum, spine-like dorsal setae, leg seta *ta3* equal in length to tarsus I, *g3* equal to tibia I; leg II *g2* equal to tibia I; *ta16* legs I-II long and tapering, terminal tarsal seta leg IV longer than entire leg. Tragardh shows three pairs of "suckers" on the suctorial plate. Also four spine-like processes are illustrated on the margin of the suctorial plate similar to those of *M. undulatus*. In 1929 Oudemans placed *A. digitiferus* (Tragardh), 1904 and *A. dionychus* Oudemans, 1910 in the newly created genus *Myianoetus*. In 1924c Oudemans erroneously identified *Hypopus setipes* Koch, 1847 as *Anoetus crenulatus* Oudemans 1909; in 1937 he corrected this error and synonymized *Hypopus setipes* with *Myianoetus digitiferus*.

Collections. – Collected by C. L. Koch on *Crytoneura stabulans*, 1847; by W. Lunbeck on a fly, Orpiksuit, West Greenland, July, 1900; by S. J. Schmitz on *Plecotus auritus* L., 1910.

Types. – No record. Plesiotypes (*M. dionychus*) in Oudemans' collection.

GENUS *Prowichmannia* Radford, 1950

Diagnosis of genus. – Diagnosis is based on the deutonymph. Coxae I, III, and IV with discs. Suctorial plate with two functional suckers, and three pairs of oval discs equal in size, and smaller than suckers.

Type. – *Prowichmannia spiniferum* (Michael), 1901.

Prowichmannia spiniferum (Michael), 1901

(Plate 68)

Histiostoma spiniferum **Michael, 1901; *Anoetus spiniferum*** **(Michael), 1901 [Oudemans, 1903b]; *Prowichmannia spiniferum*** **(Michael), 1901 [Radford, 1950]; *Wichmannia spiniferus*** **(Michael), 1901 [Oudemans, 1929].**

Female. – (Plate 68). Length 0.260 mm.; width 0.100 mm. *Venter.*

– (No figure). Pedipalpal seta less than one-third length of tarsus I; *Dorsum.* – Granular, shape oblong. Rostrum clearly defined. Hysterosoma pointed posteriorly, four pairs of large setae borne on conspicuous elevations. The two pairs of anterior setae longer than hysterosoma; third pair one-third shorter; posterior pair nearly one-half again longer than hysterosoma. Propodosomal setae not shown. *Legs.* – Long and slender, proportion of joints, if accurate, unique for this anoetid; tarsi especially long. Typical complement of setae not shown.

Male. – Not observed.

Deutonymph. – (Plate 68). Length 0.200 mm.; width 0.120 mm. *Venter.* – Fused pedipalps longer than tibia I; pedipalpal seta *pp1* equal to genu I. Sternum *st1*, *st2*, and apodeme *a2* continuous with apodemata *a4* which latter are united in midline; *st2* separated at posterior end, united with apodemata *a5* and *st3*. Sterna *st3* and *st4* not united. Coxa I and III with discs smaller than coxa IV disc *di3*. Suctorial plate heart-shaped with two functional suckers *su* larger than the three pairs of equal, oval posterior discs. *Dorsum.* – Propodosoma smooth; hysterosoma granular. Setae minute, hairlike and equal. *Legs.* – Long and slender. Setae *tal6* legs I-IV tapering. Typical complement of leg setae not described or shown.

Remarks. – Features useful in identifying this species are as follows: for the female, *pp1* medium length, soma granular, long, and narrow, with four pairs of conspicuous elevations which bear setae; setae long and heavy, of varying lengths; for the deutonymph, length of fused pedipalps, seta *pp1* arrangement of apodemata, coxa I, III, and IV discs; heart-shaped suctorial plate, plate suckers and discs as for genus, granular hysterosoma, minute and equal dorsal setae, all legs with claws, and tapering setae *tal6*. Further details of the morphology of this species is necessary to correctly relate the genus *Prowichmcania* to other genera of the family Anoetidae. Oudemans' description of the deutonymph is used. Length of deutonymph according to him is 0.260 mm. It is not known whether he also observed the adult. Genus named in honor of J. E. Wichmann.

Collections. – Collected by S. A. Poppe in Vegesack, Germany, 1898. (Oudemans); by A. D. Michael in a mole's nest, England, 1901.

Types. – In Oudemans' collection.

GENUS *Sellea* Oudemans, 1929

Diagnosis of genus. – Diagnosis is based on deutonymph. Suctorial

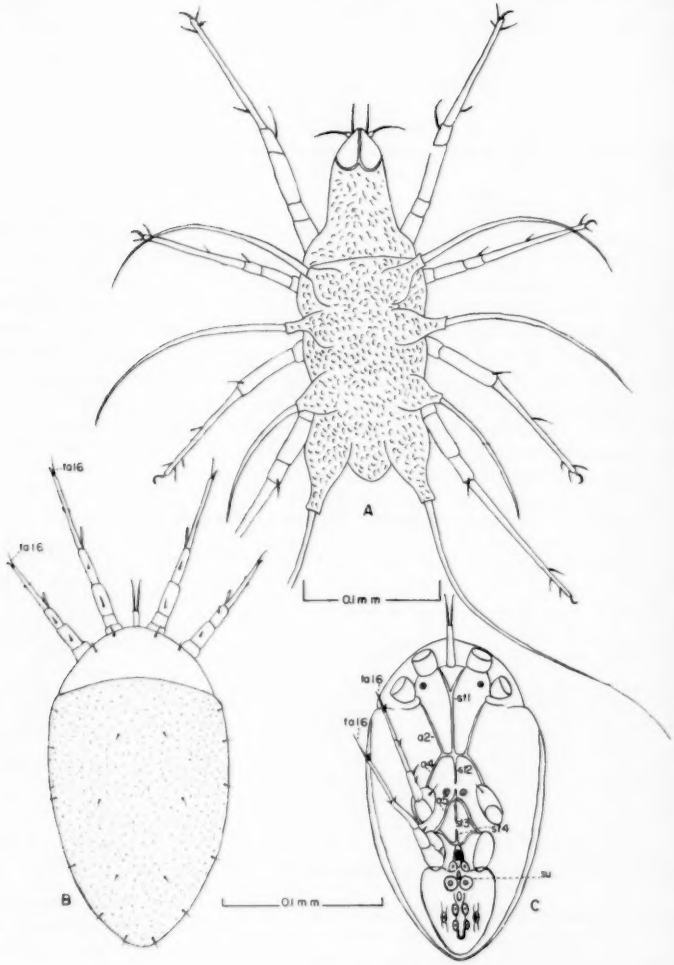

Plate 68 – *Prowichmannia spiniferum*. A – female, dorsum. B – deutonymph, dorsum. C – deutonymph, venter. (After Michael)

plate with two pairs of discs, one pair of suckers; suckers and discs of nearly equal size.

Type. — *Sellea pulchrom* (Kramer), 1886.

Sellea pulchrum (Kramer), 1886
(Plate 69)

Histiostoma pulchrum Kramer, 1886; *Sellea pulchrum* (Kramer), 1886 [Oudemans, 1929].

Female. — (Plate 69). Length 0.350 mm.; width 0.170 mm. *Venter.* — Chelicera hook-shaped distally, mesially with a series of fine teeth; pedipalpal seta *pp1* equal to tarsus II, twice length of *pp2;* a third pedipalpal seta proximal to *pp2* is illustrated by Michael probably in error. *Dorsum.* — Probably granular (not shown). Propodosomal setae not shown; hysterosomal setae of varying length as follows: *dm1* equal combined length of genu I and tibia I, *dm2* three times length of *dm1; dm3* and *dm4* nearly twice length of *dm1, dm5* very short and spine-like. Correspondence of opisthosomatic setae to other anoetids uncertain; anterior pair shorter than *dm1,* two posterio-lateral pairs longer than *dm4,* posterior marginal pair nearly equal *dm2;* apparently two pairs of dorsal setae were not observed if the setae pattern of this species is typical. *Legs.* — Legs I-II somewhat heavier than III-IV; all claws sickle-shaped. Typical complement of leg setae neither shown nor described.

Male. — (Plate 69). Length 0.350 mm.; width 0.170 mm. *Venter.* — (No figure). Gnathosoma as in female. Apodemata *a1* joined to form short sternum; combined apodemata *a2-a3* close together in midline. Ringlike structures *r1* close together on anterior portion of coxa IV; *r2* more separated, opposite anus. Seta *vp1* on coxa III, *vm1* close to lateral margin of *r1, vm3* opposite genitalia, *vo1* and *vo2* opposite anus; penial seta posteriorly directed. *Dorsum.* — Probably granular (not shown). Rostrum sculptured according to Kramer. Propodosomal seta *dp3* shorter than *pp2, dp4* long, tapering. Hysterosoma with unique large, stiff, thick spines, mounted on conspicuous bosses, flattened ventrally and convex at proximal end, gradually becoming circular in form distally, with either sharp points or rounded ends. Three pairs of these unusual setae anteriorly, nearly one-half length of hysterosoma; four pairs of similar, but smaller setae posteriorly, with smallest mesially. Other hysterosomal setae typical, and *dm1* and *dm3* nearly one-half length of hysterosoma, *do1* much shorter, *do4* longer than hysterosoma. *Legs.* — Legs I-II stouter than III-IV. All claws long, strong and slightly curved. Terminal tarsal setae legs III-IV extended slightly beyond claw. The typical complement of leg setae is not shown or described.

Deutonymph. — (Plate 69). Length 0.165 mm.; width 0.105 mm.

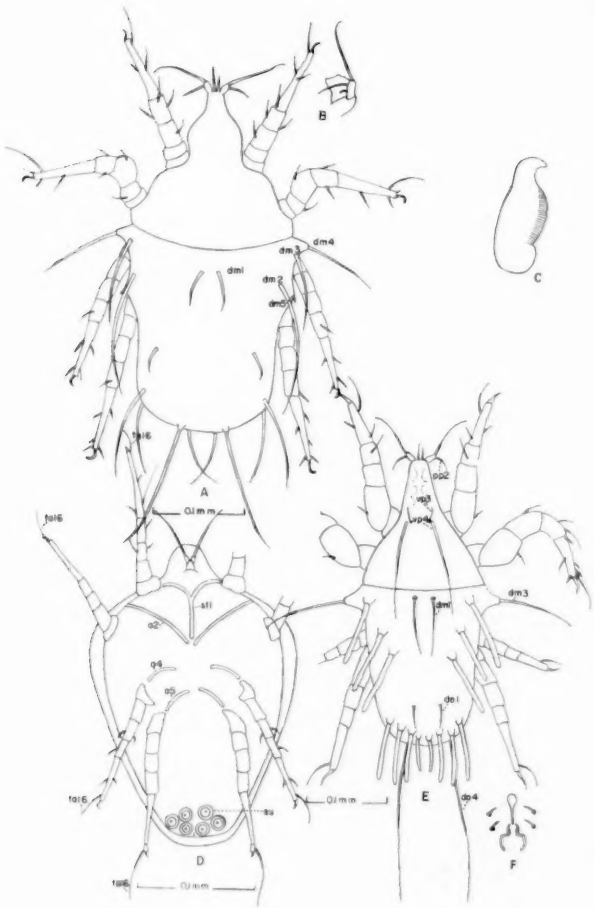

Plate 69 – *Sellea pulchrum*. A – female, dorsum. B – pedipalp. C – chelicera. D – deutonymph, venter. E – male, dorsum. F – male, external genitalia. (After Michael except composite drawing of male after Michael and Kramer)

Venter. — Fused pedipalps shorter than genu I, not extended or barely extended beyond gnathosomal base; pedipalpal seta *pp1* equal to tarsus II. Sternum *st1* and apodemata *a2* nearly joined in midline. Suctorial plate with three pairs of structures, the anterior pair of which is slightly larger, probably representing the functional suckers; two posterior discs equal in size. *Dorsum.* — Smooth, probably with minute setae. *Legs.* — Long and slender. Claws nearly straight. Seta *tal6* all legs tapering; seta *tal6* leg IV very long. Typical complement of leg setae not shown or described.

Remarks. — Features most useful in identifying the adults of this species are as follows: length of pedipalpal setae, and structures of chelicera; for the female, long tapering hysterosomal setae and sickle-shaped claws; for the male position of ringlike structures, arrangement of apodemata, unique large thick spines, and elongated typical spines on hysterosoma, claws long, strong and slightly curved, and terminal tarsal setae legs III-IV extended slightly beyond claws; for the deutonymph, short fused pedipalps, arrangement of apodemata, and arrangement of structures of suctorial plate, nearly straight claws, and tapering seta *tal6* all legs, with leg IV *tal6* especially long. This species is inadequately described by Michael and Kramer. Examination of specimens would be desirable to confirm the validity of this genus. Kramer maintained a colony of this species but described only the male. Genus named in honor of C. G. Selle.

Collections. — Collected by P. Kramer on sap of trees in Germany, 1886; by A. D. Michael on sap of trees in Warwickshire, England, 1901.

Types. — No record.

GENUS *Zwickia* Oudemans, 1924

Diagnosis of genus. — Diagnosis is based on the deutonymph. (Oudemans, 1929). Coxa I and III without discs or setae; coxa IV with seta laterad of disc *di3*. Suctorial plate with two functional suckers, two large central discs, and four discs laterally and posteriorly.

Type. — *Zwickia guentheri* (Oudemans), 1915.

Remarks. — The combination of characteristics considered diagnostic for a deutonymph of *Zwickia* have been observed only in Z. *guentheri*. Oudemans observed only one deutonymph specimen of this species, this partially destroyed by the enzymatic action of *Nepenthes* fluid. *A. nepenthesiana* and *A. gibsoni* deutonymphs and adults are strikingly similar in general appearance to Z. *guentheri*. Oudemans in 1924 considered absence of a suture between propodosoma and hysterosoma as diagnostic for

this genus. A suture in adult anoetids is often difficult to observe and hence, is an unreliable diagnostic feature. Genus named in honor of J. M. Zwicki.

Zwickia guentheri (Oudemans), 1915

(Plates 70, 71)

Anoetus guentheri Oudemans, 1915; *Zwickia guentheri* (Oudemans), 1915 [Oudemans, 1924].

Female. — (Plate 70). Length 0.450 mm.; width 0.285 mm. *Venter.* — Chelicera with wide base and with approximately fourteen teeth, curved and tapering distally. Pedipalp anteriorly directed; *pp1* anteriorly directed, nearly equal to genu I, twice length of laterally directed *pp2*. Ringlike structures large, nearly round; *r1* posterior to coxa II; *r2* on coxa IV. Anus close to posterior margin. Ventral setae hairlike, variable in length; *vp1* longer than tarsus I; *vm1* on line with *r1* near midline, nearly equal to genu I; *vm2* equal tarsus I; *vm3* equal tibia I, posterior to *r2;* opisthosomatic setae close to and opposite anus, equal to or shorter than genu I; *do7* ventral and marginal, equal to *vp1*. Small pit-like structures similar to those of *A. gibsoni* located mesiad and posteriad of vulva. *Dorsum.* — Smooth, without distinct suture between propodosoma and hysterosoma. Setae generally long, and fine; rostral setae and propodosomal setae nearly equal to tarsus II; hysterosomal setae variable, arranged in marginal or submarginal positions. Designations used for dorsal setae of other species are made on the basis of relative positions; *dm2*, *dm3*, and *do1* equal to tarsus I; other hysterosomal setae equal, nearly equal, or longer than tarsus II; *dm4* and *do7* shown as ventral in position; *dm1* not shown. Bursa copulatrix marginal. *Legs.* — Legs generally long and slender especially II-IV. Setae typical in number and arrangement except: *ta1* and *ta2* leg I and *ta1* leg II not shown, tarsus IV with extra seta; setae generally long and fine especially setae *f* legs I-II and leg IV, *t* leg III, and *ti2* leg I. Claw I long, slightly curved, claw II longer, claw III longer and nearly straight; claw IV indistinct in figure. Legs III-IV terminal tarsal setae very long, nearly equal to idiosoma.

Male. — (Plate 70). Length 0.320 mm.; width 0.165 mm. *Venter.* — Gnathosoma as in female. Sternum long, combined apodemata *a2* and *a3* united in midline, *a5* connected in midline. Ringlike structures nearly round; *r1* close together above genitalia, *r2* opposite anterior end of anus. Setae generally long, hairlike, variable in length, except *vm3* which is short and spine-like. Position of setae as follows: *vm1* anterio-mesiad of *r1*, *vm2* anterio-laterad of *r1*, *vm3* anteriad of *r2*, *vo1* mesiad of *r2*, *vo2* opposite posterior end of anus, *vo3* posterio-laterad of anus. Penial seta

anteriorly directed and with two genital spicules. *Dorsum.* — Smooth, without distinct line of demarcation between propodosoma and hysterosoma. Setae long, hairlike, arrangement typical except: *dm4*, *do4* and *do5* on venter; medial setae generally shorter than marginal and submarginal setae. *Legs.* — Legs I-II considerably larger than III-IV. Setae number and arrangement typical, except: leg I seta *f*, either *g3* or *g4*, *ta2* missing, and leg II seta *t* missing; setae generally long, especially *f* legs II and IV, *t* leg III, and *ti2* legs I-II; *ta1* legs I-II are shown as typical setae rather than as micro-sense organs. Claw I heavy, typical of most male anoetids; claw II exceptionally long, sickle-shaped; claws III-IV cannot be identifield with certainty. Legs III-IV terminal tarsal setae longer than idiosoma.

Deutonymph. — (Plate 71). Length 0.225 mm.; width 0.145 mm. *Venter.* — Length of fused pedipalps equal to width, not extended beyond gnathosomal base; pedipalpal seta *pp1* nearly twice length of tarsus II. Sternum *st1* free posteriorly; apodemata *a2* curved toward midline and continuous with *a4; a4* not united in midline; *st3* and *st4* united. Coxae I and III without discs or setae; coxa IV seta *vm1* laterad of small discs *di3;* suctorial plate relatively small; functional suckers *su* and four posterior discs equal to coxa IV disc; central discs twice as large. *Dorsum.* — Sculptured (not shown in figure). Setae fine, minute, and equal. Propodosomal setae nearly marginal. Typical complement of dorsal setae not shown. *Legs.* — Legs I-II longer than III-IV especially tarsi. Setae arrangement typical except for several missing leg IV and missing *g3* leg II. Leg I seta *ta3* longer than tarsus I, *ta1* equal to *ta2*, setae *ta16* leaf-shaped distally; leg II *ta16* tapering; leg III terminal tarsal seta equal to tibio-tarsus III; leg IV terminal tarsal seta nearly as long as hysterosoma. It is not known whether or not claws III-IV are missing, reduced or represented by long terminal tarsal setae.

Remarks. — Features useful in identifying the adult of this species are: anteriorly directed pedipalps, generally short pedipalpal setae, position of ringlike structures, generally long dorsal setae, and extremely long terminal tarsal setae legs III-IV; for the female, long ventral setae except for genital and anal setae, and unique medial setae except *vm3*; for the deutonymph short fused pedipalps, long setae *pp1*, arrangement of apodemata, small suctorial plate, minute dorsal setae, shape of *ta16* legs I-II, long terminal tarsal setae legs III-IV, as well as features diagnostic for genus. Worthy of note is the habitat of this species in common with a morphologically similar species *A. nepenthesiana* from the pitchers of *Nepenthes sp.* Numerous small animals have been observed as victims of the digestive enzymes of *Nepenthes* pitchers, among them the orbatid mites. Forms such as Diptera larvae were observed with mites as early as 1910 (Jensen) apparently not disintegrated by the digestive enzymes. Comparison of this species should also be made with another

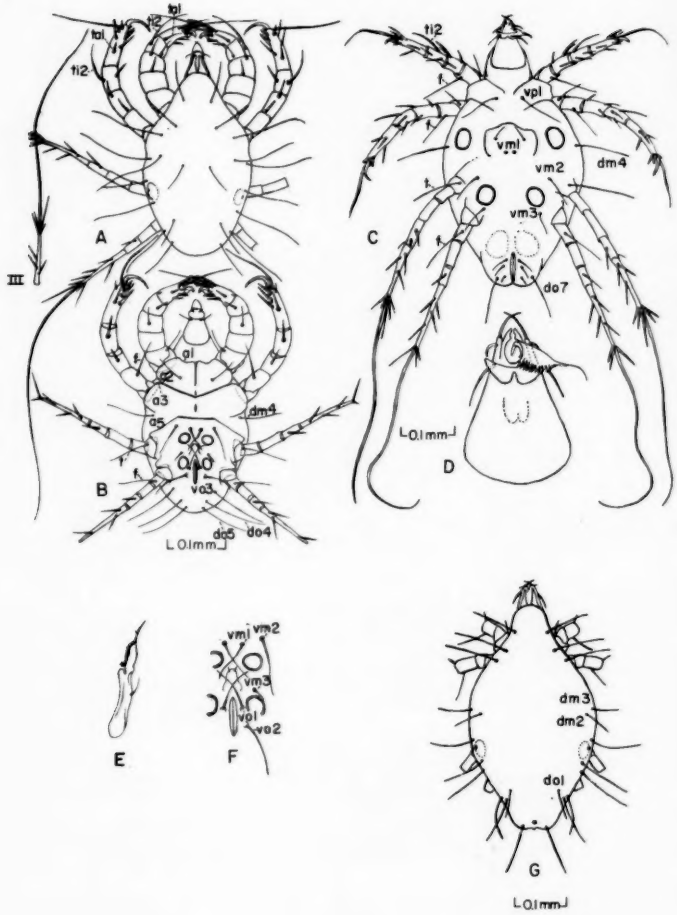

Plate 70 – *Zwickia guentheri*. A – male, dorsum. B – male, venter. C – female, venter. D – gnathosoma. E – chelicera. F – male, external genitalia. G – female, dorsum. (From Vitzthum after Oudemans)

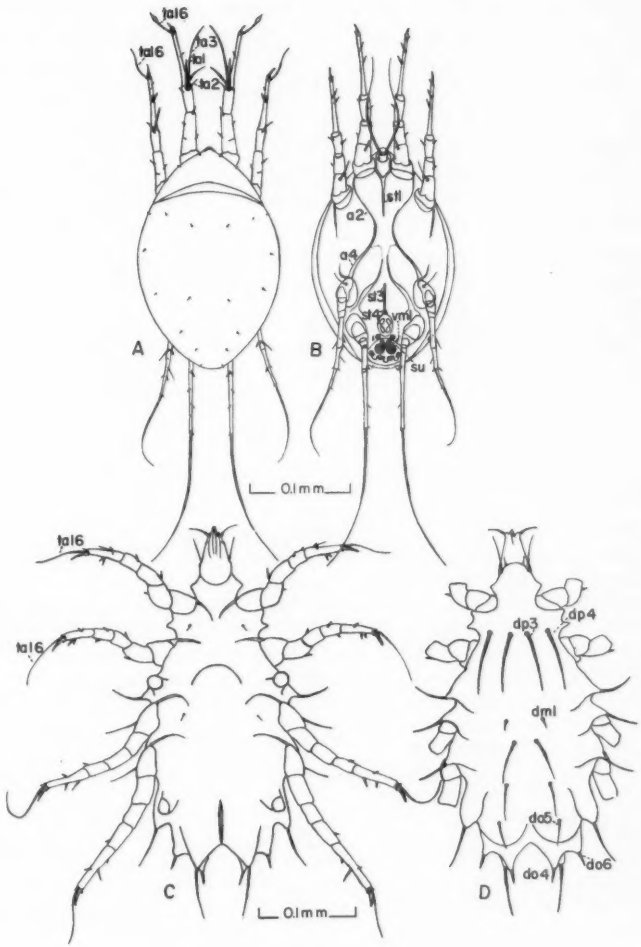

Plate 71 – Upper, *Zwickia guentheri* deutonymph. A – dorsum. B – venter. (From Vitzthum after Oudemans) Lower, *Zwickia colocasiae* female. C – venter. D – dorsum. (After Vitzthum)

morphologically similar species *A. gibsoni* collected from the pitchers of *Sarracenia purpurea* L. by Nesbitt. Vitzthum claims the fluid from this plant is quite different from *Nepenthes* fluid. Nesbitt says the two fluids are similar, substantiating his statement by the fact that copepods of the same genus have been found in each. Other water dwelling forms of this family so far observed are *Z. colocasiae* from axil fluid of *Colocasia indica*, *H. cyrtandrae* from axil fluid of *Colocasia indica* and *Cyrtandra glabra*, and also in a goldfish tank, and *H. nigrellii* from a goldfish tank. Oudemans states that the normal position of adult legs III is anterior. Of the eighty-nine samples examined by him only one deutonymph was observed.

Collections. — Collected by K. Guenther in pitchers of *Nepenthes distillatoria* L., Ceylon, 1911; from *Nepenthes gymnamphora* pitchers in Sumatra and Java, before 1931.

Types. — No record.

Zwickia colocasiae (Vitzthum), 1931, new combination

(Plate 71)

Anoetus colocasia Vitzthum, 1931

Female. — (Plate 71). Length 0.320 mm.; width 0.165 mm. *Venter.* — Pedipalpal seta *pp1* equal length of genu I; *pp2* not illustrated by Vitzthum. Ringlike structures nearly round, borne on conspicuous elevations; *r2* posterior to coxa IV. Anus close to posterior end; posterior margin is conspicuously indented. Only coxa I and III setae shown. *Dorsum.* — Smooth with distinct nearly pointed marginal bosses, without distinct line of demarcation between propodosoma and hysterosoma. Setae generally long except very short *dm1*, short spine-like *do4* and *do6*, *do5* of medium length borne on rounded elevation, propodosomal setae *dp3* and *dp4* equal, longer than other setae. *Legs.* — Legs long and slender with relatively short tarsi I-II. Typical complement of leg setae not illustrated or described; terminal tarsal setae legs III-IV equal *ta16* legs I-II. Claws equal to tibia I, slightly curved.

Male. — (No figure). Length 0.245 mm.; width 0.128 mm. Similar in general appearance to female except for legs I, III, and IV which are nearly twice as thick as those of female, and with heavier sickle-shaped claws.

Deutonymph. — No information.

Remarks. — Features useful in identifying the female of this species are as follows: ventral ringlike structures borne on conspicuous eleva-

tions, dorsal setae generally long, propodosomal setae *dp3* and *dp4* longer and equal in length, distinct nearly pointed elevations marginally, all legs with long terminal tarsal setae, claws longer and less curved than typical for most anoetids. This species is insecurely placed in the genus *Zwickia* on the basis of the general appearance of the female. (Oudemans, 1924b).

Collections. — Collected by Vitzthum near the Sea of Ngebal in middle Java, before 1931 on leaf of Araceae *Colocasiae indica*.

Types. — No record.

Nomina dubia

A number of species in the literature presumably belonging to the family Anoetidae are so inadequately described that it would serve no useful purpose to record here the little information which is available. These are as follows:

Bonomoia sphaerocerae Vitzthum, 1922

**Creutzeria tobaicae* Oudemans, 1932

**Cederhjelmia quadriucinata* Oudemans, 1931

Histiostoma brevipes Banks, 1906

Histiostoma flagellifer (flabelliforme) Leonardi, 1897.

Histiostoma genetica Stolpe, 1938

**Histiostoma phyllotrichus (trichophorus)* Berlese, 1883

Histiostoma tarsalis Banks, 1910

Hypopus tarsispinus Oudemans, 1910?

**Myianoetus mixta* Oudemans, 1911

Myianoetus tibetata Vitzthum (no date) [Buitendijk, 1945]

Nodopalpus ulmi Karpelles, 1893

Zschachia laevis Oudemans, 1929

*Specimens in Oudemans' collection [Buitendijk, 1945]

DISCUSSION

Morphology. — The anoetids are minute organisms, the females

ranging in length from 0.770 mm. (*H. berghi*) to 0.250 mm. (*Glyphanoetus horridum*). Typically the males are about the size of tritonymphs of the same species, and range from a length of 0.390 mm. (*H. berghi*) to 0.167 mm. (*Glyphanoetus horridum*). In some species, however, the length of the male does not differ greatly from the female, e. g. *Sellea pulchrum*. There may be very considerable differences in the sizes of individuals of all stages in the same culture of the same species. (Plate 13.) These size ranges generally may be attributed to nutritional differences. Adult anoetids are nearly rectangular in outline, or pear-shaped, with no striking departures from this shape in any species. Except for the deutonymphs, the color of all stages of all species is whitish-opaque, the degree of opaqueness depending upon the amount of crystals or pseudocrystals contained in the body. The deutonymphs of the various species range in color from almost white to reddish brown.

There is remarkable uniformity in the leg and body setae number and general setae pattern in this family. All species studied from well preserved specimens by us conform to the number and pattern found in *H. julorum*. Minor exceptions to this rule are: *Myianoetus* females with extra ventral seta *vo-x;* adults of *H. murchiei* leg II with supernumerary sensory tarsal seta *ta-x;* pedipalpal seta *pp2* in the adults either minute or missing, in the deutonymph *pp2* missing. *Anoetus gibsoni* male *pp2* either minute or missing.

In spite of the similarity of general appearance, and the uniformity of setae pattern and number, detailed studies reveal marked dissimilarities among species. Some of the features which are most often variable, and hence, useful in species determination are as follows for adults:

chelicerae — shape, number of teeth, etc.
pedipalps — lengths and relative lengths of *pp1* and *pp2*
ringlike structures — size, shape, position
sculpturing — presence or absence, type, degree. Sculpturing most often seen dorsally on rostrum
pitted dorsum — pitted, granular, or shagreened dorsum — presence or absence, type
protuberances — presence or absence, size, etc.
claws — shape, size, single or divided
body setae — shape, length, fineness, relative position
leg setae — shape, length, position
external genitalia — size, structure, with or without genital plate, especially male
bursa copulatrix — position, size, shape, direction of orifice

Deutonymphs: In addition to many of the characters above, the

type and arrangement of apodemata and details of suctorial plate are useful in identifying deutonymphs.

Sexual dimorphism. — Males differ from females in the following secondary sexual characteristics: generally smaller; in all males examined carefully, one less opisthosomatic seta (*do7*), (See p. 18); ringlike structures generally closer to genitalia; typically seta *ta15* leg I nearly claw-shaped; claws often somewhat more massive; other minor differences which are not typical for most species, such as serrated claws III-IV in male (*H. julorum*) and barbed seta *ta5* legs III-IV in female (*H. phyllophorus);* pilose dorsal setae in female *(H. piloseta)* and in deutonymph (*H. tienhoveni*); legs I-II tibial setae *ti2* appear to be sensory as tarsal I-II setae *ta1 (Myianoetus undulatus),* terminal tarsal setae *ta9* legs III-IV longer in male than in female *(Anoctus gibsoni).*

Life cycle. — Only the life cycle of *H. julorum* has been examined carefully, although there have been many opportunities to observe the larval and nymphal stages of many species. It appears that with only one possible exception the stages of all species observed correspond to those of *H. julorum, i. e.* egg — larva — protonymph — deutonymph (this stage may be omitted) — tritonymph — adult. The possible exception is *H. murchiei* in which no tritonymphs have been observed. (See p. 93). It is interesting that some larvae of the same species and in the same culture metamorphose directly into the tritonymph stage, omitting the deutonymph. This phenomenon cannot be explained at present.

Habitat. — The anoetids have been reported from a wide variety of habitats. Two common features of the habitats of all trophic forms are abundance of organic matter usually in a state of putrefaction and abundant moisture. Most species which have been examined in the laboratory appear to be continuously feeding on the surface film of fluid containing yeasts and other microorganisms. *H. nigrellii* and *H. cyrtandrae* appear to thrive completely submerged and can be seen feeding among aquarium plants on debris. Nigrelli (1954) was led to believe that these two species gave off substances sufficiently toxic to kill fish. *H. cyrtandrae,* however, can be cultured readily on moist standard media (see p. 60). The only two species which are known to be parasitic are *H. murchiei* and *H. berghi* which destroy the eggs of earthworms and leeches respectively. (see p. 91 and p. 51). Yeast culture media used in *Drosophila* stocks are favorable media for many anoetids. Mites may accumulate in such large numbers that they become pests. In addition to competing for available food, the deutonymphs may attach to the mouth parts and genitalia of *Drosophila* in sufficient numbers ot interfere with feeding and copulation. Although anoetids have been reported from many temperate and tropical parts of the world and in a variety of niches, it must be pointed out that we do not yet have adequate knowledge of the

possible habitats of tropic forms since the majority of species described are based on the non-feeding deutonymph which attaches itself readily to any passing insect and in this manner may effectively disperse a species over wide areas and away from original nutritional source.

Chromosomes. — Preliminary studies of the chromosome number for various species have been undertaken. These studies show that the chromosome numbers vary among the species and that the number is relatively small, *e. g. A. laboratorium*: haploid number — 4. The chromosome count is made on early cleavage divisions of the uterine egg. Such observations are not only useful in speciation problems but also to establish whether a given species is or is not arrhenotokous.

Mode of reproduction. — Approximately twenty species of anoetids have been cultured in our laboratory. Of this number four species reproduce by thelytoky, no males being produced. In some sixteen species both males and females are produced. Careful isolation studies of virgin females have not been made on all sixteen species. However, such studies were made on about ten species. In all except one of these ten species, unfertilized eggs developed parthenogenetically, giving rise to males only. Fertilized eggs gave rise to females only. Thus arrhenotoky is probably the mode of reproduction for most of the sixteen species referred to above, including *A. laboratorium*, as confirmed cytologically. In one species, *H. fimetarium*, prolonged attempts to obtain offspring from virgin females failed. Yet the sex ratio in this species was similar to a typical arrhenotokous species, *i. e.* the ratio of males to females was not 1:1 but highly variable. This suggests that the males are haploid as in the haplo-diploid parthenogenetic forms. It appears, however, that although the mode of reproduction and sex determination in *H. fimetarium* is probably the same as for typical arrhenotokous species, pseudofertilization or at least insemination is necessary to initiate development of male producing eggs. Tentatively it must be concluded that in some manner insemination is necessary to initiate development of eggs of this species.

Diploid parthenogenesis is not an uncommon mode of reproduction since it is found occasionally in many animal phyla. On the other hand, male parthenogenesis is of much rarer occurrence, it having been found in only five groups of animals. It appears to be common among the Acarina so far investigated and the predominant type of reproduction in the Hymenoptera. As White (1954) and others have pointed out, male and female parthenogenesis are entirely different modes of reproduction and could be expected to evolve separately over long periods of time as appears to be the case for Hymenoptera. It is of interest to note in this connection that in *H. humiditatis* and in an undescribed "variety" of this species in our collection and in *H. feroniarum* both thelytokous and ar-

rhenotokous "varieties" occur in essentially the same habitat. The female of the thelytokous "variety" is virtually indistinguishable from the arrhenotokous "variety" in each of the two species. This would seem to indicate the extreme plasticity of modes of reproduction in the Anoetidae or that arrhenotoky and thelytoky are not unrelated modes of reproduction, at least in Anoetidae.

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*Valid species.

News and Notes

(Editor's Note: News contributions should be sent to the person whose name appears at the end of the appropriate sections.)

THE PRESIDENT'S MESSAGE

The thirty-sixth annual meeting of the Virginia Academy of Science will be held at the Hotel Roanoke on May 7-10, 1958. It is indicative of the widening interests of our membership that this meeting will be sponsored by Hollins College, Roanoke College, Virginia Polytechnic Institute, American Viscose Corporation, Norfolk and Western Railway, and the Veterans Administration Hospital. The Local Arrangements for the meeting are being handled by a Committee drawn largely from these institutions and under the very capable chairmanship of Dr. Boyd Harshbarger. With full cooperation between this strong committee and the officers and members of the Academy, we are confident that these arrangements will be as satisfactorily complete as they can be made.

It goes without saying that a great deal of the value of the Annual Meeting depends upon the quality of the programs of the individual Sections; it is, therefore, a pleasure to acknowledge the able assistance of the officers of the several Sections in helping to insure the success of the Roanoke meeting. It is through these officers too, that the Academy invites entrants for the J. Shelton Horsley Research Award which is given each year for a "highly meritorious" paper presented at the May meeting.

This year of the Sputniks will be a particularly significant one for the future of science in our State as, on all sides, we see a quickened interest in the development of our scientific potential. How best to operate in this favorable clime in "encouraging scientific research" and sustaining "public interest in science" will be, as it should, a main concern for our whole Academy membership in the days immediately ahead.

It is with such ends in view that the members of the various Academy committees are continuing to work. For them, as for the Junior exhibitors and those who will be reporting the results of their scientific investigations, a banner attendance at Roanoke would provide the very finest encouragement.

W. G. GUY, *President*

PAUL RANDOLPH BURCH

Professor Paul R. Burch, a member of the Radford College Faculty and the Chairman of the Biology Department from 1928-1953, died January 9, 1958.

Doctor Burch was deeply respected by his students and colleagues and a great loss was felt by them when he retired in 1953. His death on January 9th has magnified this loss. His contagious enthusiasm for meeting a challenge in science or other fields of endeavor, his intense participation in any cause he championed, his integrity, and common sense, combined to make Paul Burch a refreshing personality who gave enduring inspiration to his students and who will continue through them to inspire the lives of their students.

— Andrew L. Ingles, *Radford College*

MINUTES OF THE COUNCIL MEETING

Longwood House, Farmville, Virginia

October 20, 1957

The meeting was called to order by President William G. Guy at 1:30 P.M. In addition to the council members, President Guy had invited section and committee chairmen to meet with the council. Members in attendance were: Lynn D. Abbott, Jr., Robert T. Brumfield, John C. Forbes, Irving G. Foster, Edward S. Harlow, Charles F. Lane, Paul M. Patterson, and Foley F. Smith.

The meeting was preceded by a luncheon where President Francis G. Lankford and Dr. George W. Jeffers represented the host institution, Longwood College. President Lankford welcomed the group. President Guy invited both to stay through the ensuing meeting, but Dr. Lankford was unable to do so.

Section chairmen present were: J. C. Holmes, *Chemistry;* Noble R. McEwen, *Psychology;* Vera B. Remsburg, *Science Teachers;* and Otis L. Updike, Jr., *Engineering.*

Committee Chairmen other than those on Council, R. A. Clayton, *Chairman, Membership Committee* and A. B. Massey, *Chairman, Virginia Flora Committee* also attended.

SECTION REPORTS

Dr. Holmes reported that an objective for the coming year was to

strike a numerical balance between industrial and academic reports in the Chemistry Section.

Dr. Updike reported similar effort in the Engineering Section.

Dr. McEwen reported he was working for a balance in papers between academic and clinical psychology.

Mrs. Remsburg reported for the Science Teachers Section that the program for the Roanoke meeting was well in hand.

COMMITTEE REPORTS

Dr. Massey reported on recent taxonomic publications in the state.

Dr. Clayton said there were some 860 members of ACS in Virginia not members of VAS and a solicitation of them is being made.

He further stated that the Academy is not well known in Northern Virginia, and he hopes to send information about VAS to about 1000 biologists, engineers and science teachers in that area.

President Guy reported that E. D. Crittenden, Chairman of the Education Committee regretted his inability to be present. In this connection the President stated that in conversation with Dr. Paschall, State Superintendent of Education, he had learned that it is the thinking in the State Department of Education that the requirements for teacher certification in science will be raised and that an advisory committee on education in scientific fields will soon be set up.

Dr. Abbott, reporting as Chairman of the Long Range Planning Committee, said a subcommittee had been organized to look into possible sources of funds for the Virginia Academy particularly for a proposed study of the results of the science talent searches.

Mrs. Heatwole reported by letter that the initial organization for the year had been made for the Junior Academy of Science. Funds for the Junior Science Bulletin and prizes are being requested again from the American Tobacco Company and the Philip Morris Company.

OLD BUSINESS

SEASHORE STATE PARK

Following the instructions in the minutes of May 11, 1957, visits were made to the University of Virginia, Virginia Polytechnic Institute, and William and Mary. Edward Harlow reported that the University

of Virginia is not interested in participating in setting up a State Science Center in the Park. However, Virginia Polytechnic Institute and the College of William and Mary did indicate interest. President Chandler has promised to discuss the matter with the Council of Higher Education.

CONCERNING THE DISMAL SWAMP PROJECT, President Guy reported that J. T. Baldwin has not had time to work on this recently, but is interested, and will continue to pursue the project.

President Guy announced the appointment of two new committees: The Committee of Public Information. A formal committee was thought inadvisable but a group should be segregated to disseminate information for the press informally. The Council moved and passed that this matter be left to the President's discretion. Committee on the History of Science in Virginia. I. G. Foster has agreed to be Chairman of the Committee, and each section is requested to designate a member to cooperate with this Committee.

Auditing the treasurer's books by an Academy Committee was authorized as an experiment as was done last year. The question arose as to whether we should so continue or return to CPA auditing. Council passed a motion to have the books audited this year by CPA. If CPA auditing every other year for a two year period is cheaper than annual auditing the Council may entertain a constitutional change.

Robert Brumfield, Editor of the Journal, reported the Journal in good condition. The need for an advertising manager is acute at the moment. Ed Harlow reported one or two possible candidates. His main report centered about the mounting cost of publication and the sharp reduction in reserve funds. Additional funds for the Journal is becoming imperative. Charles Lane, as Managing Editor also reported briefly.

Robert Brumfield, Chairman of the Research Committee, gave a report on grants made so far and the balance of research funds. He thought rather few people knew about these funds, and their existence should be better advertised.

NEW BUSINESS

A proposal that VAS investigate participation with the Engineering Societies of the Richmond area was proposed by letter by Henry Leidheiser, Jr. Instead of sending two Engineering Section representatives, as suggested, Council decided upon motion that the President appoint representatives as follows: One, Leidheiser, as a member of the Long Range Committee, and one member of the VAS Engineering Section resident in Richmond area for the purpose of examining their proposals

more carefully. It will be noticed that Council modified the request on representation.

Dr. Forbes presented a plan for stimulating research principally during summer vacations by scientists in the academic professions in Virginia, principally the younger teachers. There is first the question as to how widespread an interest in this exists and if so, how to accumulate funds for its implementation. Council passed a request that the President appoint a committee to survey the demand for such possible opportunity preliminary to an effort to raise funds. Various suggestions as to possible areas of available funds were made in case the need was found to be real.

The Secretary was instructed to send a message to Marcellus Stow regretting his absence due to illness and sending him the Council's sympathy.

Adjournment

— Paul M. Patterson, *Secretary.*

AGRICULTURAL SCIENCE SECTION

Tobacco disease research should get quite a boost from the new facilities now being constructed at the Tobacco Disease Research Station, Chatham, Virginia. These facilities consist of an office and laboratory building with a connecting greenhouse, a tobacco compartment curing barn, a combination shop and machinery storage shed, a tobacco stripping, grading and storage building and a small residence for the station foreman. The professional staff at the Chatham station includes Mr. J. L. LaPrade, Dr. Wirt H. Wills, and Dr. J. L. Troutman. The work at this station is administered through the Department of Plant Pathology and Physiology, Virginia Polytechnic Institute, Blacksburg.

Paul M. Reaves, a member of the Dairy Science staff at the Virginia Polytechnic Institute, received the first Wine Teaching Award in the School of Agriculture. Along with the award a check of $500 was presented to Professor Reaves. Reaves joined the Dairy Staff in 1928 and teaches courses in dairy production.

Dr. W. A. Hardison, Department of Dairy Science, attended a Trace Mineral Symposium at Wooster, Ohio. He is at present conducting research on the copper requirements of dairy calves.

Mr. Harold W. Walker has been assigned as Assistant Agricultural Economist with the Extension Service at the Virginia Polytechnic Institute. Mr. Walker's work will be primarily in poultry marketing. He is a 1950 graduate of the Virginia Polytechnic Institute, and previously has been

engaged in farming and working with Rocco Feeds, Inc., Harrisonburg, Virginia.

Assistant Professor of Business Education, J. C. Hall, resigned his position in the Department of Vocational Education at the Virginia Polytechnic Institute on September 1, 1957, to accept a position as head of Business Education at the Alabama Polytechnic Institute. Mr. J. R. Stewart who completed his work for the Master's degree during the past summer has been appointed as Dr. Hall's successor.

Mrs. Lucy Crawford, who holds two degrees from Furman, assumed her duties as Associate Professor of Distributive Education on July 1, 1957, succeeding R. L. Almarode who resigned last April. Mrs. Crawford heads the recently organized program at the Virginia Polytechnic Institute for training teachers in the joint vocational fields of Distributive Education and Diversified Occupations.

Under the direction of Dr. J. S. Carpenter, Associate Professor of Trade and Industrial Education, progress is being made in organizing a curriculum for training trade and industrial teachers. Much of Dr. Carpenter's time during the past year has been devoted to off-campus classes for teachers of trade and industrial subjects in the schools at Wise, Abingdon, Roanoke, Fishersville, and Danville.

Dr. B. C. Bass, Associate Professor of Agricultural Education completed "A Study to Determine Units in the Area of Farm Management That Should Be Taught Students in Vocational Classes."

Dr. T. J. Horne, Professor and Head of Agricultural Education at the Virginia Polytechnic Institute, was one of three participants in a recently completed Southern Regional study entitled: "What Constitutes an Effective Program of Vocational Agriculture in a Community." Conclusions of the study were based on information secured from high school youth, young farmers, adult farmers, teachers of vocational agriculture, principals, and superintendents in the twelve Southern States. Dr. Horne is now serving as chairman of the National Research Committee in Agriculture Education.

—Carl W. Allen, *Virginia Polytechnic Institute.*

ASTRONOMY, MATHEMATICS, PHYSICS SECTION

Prof. J. G. Stipe has returned to the Physics staff at Randolph-Macon Woman's College after a year as a Carnegie Intern in General Education at Harvard University.

At the University of Virginia Drs. Berko, Plaskett, and Whitehead have been promoted to Associate Professorships. Dr. Berko has recently

received a Sloan Foundation Fellowship.

The Physics Department at the Virginia Polytechnic Institute has received a grant of $159,700 from the AEC for the purchase of laboratory equipment in nuclear physics and engineering. Dr. Theodore E. Leinhardt, formerly with Sperry Gyroscope Company, has been appointed Associate Professor of Physics.

Dr. W. O. McMinn, recently at Clarkson College, and Dr. John McKnight, 1957 graduate of Yale University, have joined the Physics staff at William and Mary. Dr. Frederick O. Crownfield has been promoted to Associate Professor of Physics.

Dr. A. D. Campbell has been promoted to Associate Professor of Physics at the University of Richmond.

Dr. A. N. Vyssotsky, Professor of Astronomy at Leander McCormick Observatory of the University of Virginia, has been elected a vice-president of the American Astronomical Society.

Dr. E. R. Dyer, Jr., is on leave from McCormick Observatory serving as Assistant Professor of Astronomy at Georgetown University. Dr. Valfred Osvalds has been appointed acting Assistant Professor of Astronomy at McCormick Observatory.

—Irving G. Foster, *Virginia Military Institute*

BACTERIOLOGY SECTION

Dr. Holmes T. Knighton, Medical College of Virginia, attended and participated in a seminar on wound healing, sponsored by the Rowe-Smith Foundation, from December 8 through 11, at Karnack, Texas.

Dr. E. Clifford Nelson attended the symposium on Animal Diseases and Human Health sponsored by the New York Academy of Science, September 11 through 13.

—P. Arne Hansen, *University of Maryland*

BIOLOGY SECTION

Dr. H. G. M. Jopson of Bridgewater College and Dr. J. J. Murray, Jr., of Washington and Lee University, each spent a number of weeks at the Oregon Institute of Marine Biology, Charleston, Oregon, during the summer of 1957.

A new greenhouse has been acquired by the Hollins College Biology Department. The structure is a single span one with aluminum frame and redwood rafters.

Longwood College has added Dr. E. F. Stillwell, a recent graduate in physiology from Duke University, to its staff as an Assistant Professor. Robert E. Merritt of Longwood, presently on leave at the University of Tennessee, is replaced this year by Dr. Jacobus M. L. Lodewijks, an exchange teacher from the Netherlands. Dr. Lodewijks was the first president of the World Federation of Aquarists. Mr. Aaron O'Bier, who received his Master's degree from the University of Richmond is now working on the AEC project at Longwood under the direction of Dr. R. T. Brumfield.

At the University of Virginia Mr. Richard D. McKensey has been appointed Instructor in Biology. Mr. McKensey will complete a doctorate in Physiological Mycology at Stanford University in January. The National Science Foundation has awarded Drs. Samuel P. Maroney and J. N. Dent a grant of $8,000.00 for the purchase of equipment to be used in research employing radioisotopes. Dr. Addison E. Lee from the Biology Faculty of the University of Texas is serving as Visiting Professor of Biology. Dr. Lee is primarily responsible for the Department's contribution to the NSF sponsored Academic Year Institute for High School Teachers being held at the University.

The twenty-eighth session of the Mountain Lake Biological Station proved to be a most successful one with 85 students and investigators working during the two terms. The professorial staff was composed of Dr. Robert T. Brumfield, Longwood College; Dr. A. C. Cole, University of Tennessee; Dr. Edward S. Deevey, Jr., Yale University; Dr. Gerhard Fankhauser, Princeton University; Dr. Thomas E. Kennerly, Baylor University; Dr. Samuel P. Maroney, Jr., University of Virginia; Dr. Gerald W. Prescott, Michigan State University; and Dr. Catherine M. Russell, University of Virginia Medical School. Phipps and Bird, Inc., presented a scholarship to one student, and the National Science Foundation provided funds for 12 Awards for students and investigators at the Station. The National Science Foundation has recently made available funds for the construction of three additional laboratories in the basement of the main building.

Dr. Willis G. Hewatt of Texas Christian University and Dr. Robert W. Ramsey of the Medical College of Virginia each taught important courses at the Virginia Fisheries Laboratory during the past summer. The *Pathfinder*, new research vessel of the Laboratory, was delivered in June, 1957, is now outfitted and in service and is proving a fine vessel for its purpose. The Fisheries Laboratory has construction well underway on a new combination laboratory-dormitory building which will considerably expand facilities for graduate students, summer assistants and visiting professors.

Among staff members of the Virginia Fisheries Laboratory — Dr.

Jay D. Andrews has been appointed Chairman of the Editorial Committee of the National Shellfisheries Association, and Dr. J. L. McHugh has been named Chairman of the Scientific Advisory Committee of the Atlantic States Marine Fisheries Commission and presided at the meetings of that group in New York in September 1957.

Important staff activities at the Virginia Polytechnic Institute include the following:

Professor J. D. Wilson retired as head of the Biology Department January 31, 1958. Professor Wilson served as head of the department for nearly 35 years. Ever active, Professor Wilson will spend the next two years as an educational adviser in India. Professor Frederick S. Orcutt, formerly professor of bacteriology, has been named acting head of the Department of Biology. Dr. J. M. Grayson attended and presented an invitation paper on insect resistances to insecticides at the Fourth International Congress of Crop Protection, held in Hamburg, Germany, September 8-15. Drs. E. C. Turner, Jr., and E. M. Raffensperger attended a work conference on systemic insecticides at Kerrville, Texas, on July 9-11. This work-shop was sponsored by the Entomology Research Service of the U.S.D.A. and several chemical companies which are developing chemicals for use as systemic insecticides. Dr. W. G. Evans attended the Eastern Alfalfa Improvement Conference held at Storrs, Connecticut, on July 15-17, where he served as a panel leader for discussion of the alfalfa weevil. Dr. J. R. Rooney, II, Professor of Animal Pathology, Biology Department, has returned from 12 months leave of absence; during this period he studied in the Royal Veterinary College, Stockholm, Sweden. Dr. W. E. Field, a graduate of Michigan State College and Wayne University, has joined the staff of Animal Pathology Section, Department of Biology as Assistant Professor of Animal Pathology. Dr. William Van Dresser, a Michigan State graduate in Dairy Science and in Veterinary Medicine, has joined the staff of Animal Pathology, Biology Department. Dr. C. J. Ackerman, Associate Biochemist, Virginia Agricultural Experiment Station, Blacksburg, was on leave for a 6-week period during the summer of 1957; Dr. Ackerman served as chief biochemist on a nutrition survey team in Lybia, North Africa. Dr. P. C. Holt, Assistant Professor of Biology, has been awarded an NSF grant in th esum of $58000 for a period of approximately two years for "Systematic Studies of the Branchiobdellidae."

The radiation pit at The Blandy Experimental Farm was completed and the Cobalt-60 source was installed and put into operation beginning July 19, 1957. The radiation field, as well as the Orland E. White Arboretum, were open to visitors at a field day held on August 15.

Dr. Robert F. Smart has been named dean of Richmond College.

Dr. J. C. Strickland has been promoted to the chairmanship of the Department of Biology at the University of Richmond.

Dr. J. D. Burke of that department was appointed research fellow of the American Physiological Society for the summer of 1957 and spent the time working with Dr. F. G. Hall in the Department of Physiology at Duke University.

Dr. W. R. Tenney formerly of West Virginia University and of Camp Detrick, Maryland – whose main interest is the physiology of fungi – has been appointed Assistant Professor in the department.

—Walter S. Flory, *Blandy Experimental Farm, University of Virginia*

CHEMISTRY SECTION

New members of the Research and Development Department of Virginia-Carolina Chemical Corporation are: Donald E. Hayford, Chemist, graduate of the Virginia Polytechnic Institute; Miss Margaret Anne Barber, Chemist, graduate of the University of South Carolina; James J. Anderson, Senior Chemist, PhD from the University of Virginia; C. F. Booth, Section Leader, General Engineering Development, former President of the Covington Fertilizer Company in Andalusia, Alabama; and Brooks M. Whitehurst, Senior Chemist Engineer, formerly with American Enka Corporation. Promotions announced in the Research and Development Department are: John M. Daniel, Jr., from Senior Chemical Engineer to Section Leader-Fertilizer Process and Mechanical Development; Robert B. McDaniel, Jr., from Patent Coordinator to Section Leader-Administration and Services; C. F. Booth, from Senior Development Engineer to Section Leader-General Engineering Development; J. P. Crowder from Senior Engineer to Group Leader-Fertilizer Process.

Dr. Bryant Harrell has received a grant from the National Institutes of Health which enabled him to carry on research at the College of William and Mary during the summer months on his project: "Synthetic Respiratory Pigments." The grant is subject to renewal for the next four years.

Under another grant from the Research Corporation for the summer of 1957, with the assistance of a recent William and Mary graduate, Edward David Eanes, Dr. Harrell devised an improved method for the "Quantitative Microanalysis of Alkoxy Groups."

From the Virginia Institute of Scientific Research –

Dr. Henry Leidheiser, Jr., participated in the International Symposium on Passivity held in Darmstadt, Germany, in early September. Sev-

eral countries took part in this conference including the United States, England, Italy, Germany, Japan, Czechoslovakia, and Norway. Dr. Leidheiser presented a paper entitled "Anaerobic Corrosion of Metals in Solutions Containing Various Metallic Cations — Passivation and Activation." Before his return home, he visited several universities in England.

Dr. Leidheiser also attended the Gordon Conference on Corrosion. Dr. R. A. Lefever attended the Gordon Conference on the Chemistry and Physics of Metals, and Dr. Carl J. Likes the Conference on Adhesion.

Mr. W. Roger Buck, III, attended the Buffalo meeting of the Electrochemical Society which was held in October.

A new addition to the staff of the Institute is Mrs. Lucille B. Garmon, a 1957 graduate in chemistry from the University of Richmond.

Dr. Karl Killer, a native of Switzerland, who joined the staff in November of 1956, has completed his year's work in electrochemistry and is returning to Europe.

October 21 through 25 the Institute sponsored its first Science Book Fair. Over 350 books from twelve leading science publishers were on display, current publications on chemistry, physics, metallurgy, and biochemistry. A book fair is planned for spring and fall each year.

From the Virginia Polytechnic Institute —

Dr. L. K. Brice has been promoted from assistant professor to associate professor.

Dr. E. F. Furtsch has been promoted from Associate Professor to a Full Professor.

Dr. R. C. Krug has been awarded an American Chemical Society-Petroleum Research Fund Grant for 1957-58. James A. Rigney, formerly of the Research Division of the American Cyanamid Co., Bound Brook, New Jersey, is working under this grant as an A.C.S. Graduate Fellow.

In September 1957 Dr. Krug was one of the first recipients of the W. E. Wine Achievement Awards for distinguished teaching. Dr. Krug was the recipient of the award in the School of Applied Science and Business Administration.

Mr. W. L. McPherson for the past year has been in charge of the planning and equipment procurement for the new radiochemical laboratory. This laboratory and its attendant class room work is a part of the Nuclear Engineering Program inaugurated this year. Professor McPherson is the graduate of several of the Oak Ridge Institute of Nuclear Studies courses as well as being a research participant in the Analytical Chemistry Division of the Oak Ridge National Laboratory.

Dr. J. W. Murray taught in the Summer Institute for High School Science Teachers June 10 through July 29. He also engaged in analytical consulting work for the Department of Geology.

Dr. Jack Vanderryn for the past three summer months has been engaged as a research participant at Oak Ridge National Laboratories. His work concerned the infrared spectroscopy of boron trifluoride and its addition compounds.

Dr. F. A. Vingiello in July attended the XVIth International Congress of Pure and Applied Chemistry meeting in Paris, France. In addition to attending the meeting he gave a talk on "An Unusual Elbs Type Reaction Observed During a Study of the Cyclization of Ketones."

The National Institutes of Health has just established a $24,000 project here for work on benzopyrenes under Dr. Vingiello's direction.

Dr. J. W. Watson is the Councilor for the Virginia Blue Ridge Section of the American Chemical Society.

—M. A. Kise, *Virginia Smelting Corporation*

ENGINEERING SECTION

Professor Frank C. Vilbrandt of the Chemical Engineering Department at the Virginia Polytechnic Institute has been appointed to the Board of Authenticators and Advisors for revision of the *New Standard Encyclopedia*. His duties will include checking each article submitted in the field of engineering for accuracy and coverage. In September Dr. Vilbrandt attended the New York meeting of the American Chemical Society, and in October he attended a meeting of chemical engineering professors at Rochester, New York, at the invitation of Eastman Kodak Company.

Professor F. W. Bull of the Chemical Engineering Department at the Virginia Polytechnic Institute attended industrial meetings of chemical engineering professors held by Esso Standard Oil Company in Baton Rouge, Louisiana; Hercules Powder Company in Wilmington, Delaware; International Paper Company in Georgetown, South Carolina; Koppers Company in Pittsburgh; the du Pont Company Experiment Station in Wilmington, Delaware; and the Texas Company in Beacon, New York. Professor Bull has announced that Mr. Russell A. Primrose and Mr. Julian F. Mote have been added to the Virginia Polytechnic Institute as Assistant Professors of Chemical Engineering.

Professor Nelson F. Murphy of the Chemical Engineering Department at the Virginia Polytechnic Institute was co-author of the Virginia Polytechnic Institute Engineering Experiment Staiton Bulletin, entitled,

"Melting Point Diagram for the System Sodium Cyanide-Sodium Carbonate." In October Dr. Murphy attended the Buffalo, New York meeting of the Electrochemical Society. In October he accompanied the senior chemical engineering students on a one-week inspection trip to chemical plants in New Jersey, Maryland, and Virginia.

A school for chemical engineering teachers, sponsored by the du Pont Company, was held in October in Charleston, West Virginia. Attending this meeting were Professors F. C. Vilbrandt, F. W. Bull, and N. F. Murphy from the Virginia Polytechnic Institute, and Professors R. M. Hubbard and O. L. Updike from the University of Virginia.

Professor Robert W. Truitt of the Aeronautical Engineering Department at the Virginia Polytechnic Institute has published a paper in the *Journal of the Aeronautical Sciences* entitled, "Flow Over Blunt-Nosed Bodies."

Mr. Tilton E. Shelburne, director of the Virginia Council for Highway Investigation and Research, attended the meeting of the National Advisory Committee to the AASHO Road Test at Ottawa, Illinois in August. He presented a paper on the design and performance of flexible pavements at the Atlanta meeting of the Southeastern Association of State Highway Officials in October. Mr. Shelburne was installed as Director for District Six of the American Society of Civil Engineers at the annual meeting held in October in New York City. Mr. James L. Eades, also of the Virginia Council for Highway Investigation and Research, presented a paper describing the recent work done by the Council on the stabilization of soils at a meeting of technical advisors to The National Lime Association in Washington in October.

Engineering Dean Lawrence R. Quarles of the University of Virginia has announced that the University has been selected as one of the schools participating in the special AEC fellowship program in Nuclear Energy Technology. He has appointed Dr. J. L. Meem as Professor of Nuclear Engineering and Director of the Nuclear Research Reactor Facility. In June and October Dr. Quarles attended meetings of the Board of Directors of the American Nuclear Society in Pittsburgh and New York. In September he attended the meeting at the Virginia Military Institute of the Research Advisory Committee of the Virginia Council of Highway Investigation and Research.

Members of the engineering school of the University of Virginia attending the June meeting of the American Society for Engineering Education held at Cornell University were Dr. L. R. Quarles and Dr. Otis L. Updike.

Professor Orville R. Harris, director of the Universtiy of Virginia

Engineering Experiment Station, attended the Frequency Control Symposium sponsored by the Signal Corps Engineering Laboratory at Asbury Park, New Jersey in May. In June Dr. Harris and Dr. Otis L. Updike attended a school on the operation of the PACE electronic computer, since one has been acquired by the School of Engineering of the University of Virginia, held at Princeton, New Jersey computation center of Electronics Associates. In September Dr. Harris attended the President's Conference on Technical and Distribution Research for small businesses held in Washington.

Professor R. M. Hubbard of the Chemical Engineering Department at the University of Virginia has returned from leave of absence for one year. During part of this time he traveled extensively through the Southern, Southwestern and Western parts of the United States, visiting the chemical industry and chemical engineering schools in those areas. During his absence, Professor R. E. L. Gildea substituted as editor for the Engineering Section. Professor Gildea has recently been commissioned by the United States Public Health Service as Senior Sanitary Engineer in the inactive reserve.

Mr. Bernard A. Niemeier has joined the Reynolds Metals Company, Metallurgical Research Laboratory, as head of the mechanical and structural testing group. During the past summer he attended a summer session on stress analysis held at Massachusetts Institute of Technology. He has been appointed to the Committee on Fatigue of the American Society for Testing Materials.

—Robert M. Hubbard, *University of Virginia.*

GEOLOGY SECTION

Chauncey C. Tillman joined the staff of the Virginia Polytechnic Institute Department of Geological Sciences in September 1957 as associate professor. He received his B.S. in Geology from the University of Michigan in 1950 and his M.S. from the same school in 1952. He has completed his course-work towards his Ph.D. from Harvard University. During parts of 1950, 1951, 1953, and 1954, Mr. Tillman was employed as a geologist by the Mineral Deposits Branch of the U. S. Geological Survey and worked on the Florida Phosphate Project and in Nevada and Utah in mine evaluation work in association with the Defense Minerals Exploration Administration program. Mr. Tillman's main interests are Paleozoic paleontology and stratigraphy.

Mark Fara was added to the staff of the Virginia Polytechnic Institute of Geological Sciences in January 1957, as assistant professor. Mr. Fara obtained his B.S. and M.S. degrees in geology from the Virginia Polytechnic Institute in 1956 and 1957, respectively. His thesis dealt with

the geology of the Parnassus, Virginia, quadrangle.

Douglas Neil Hillhouse joined the Virginia Polytechnic Institute Department of Geological Sciences as a part-time instructor in September 1957. He is also working toward his Doctor's degree. Mr. Hillhouse received his B.A. (Honors) in 1955 and his M.Sc. in 1956 from the University of British Columbia. During the 1956-57 academic year he was assistant professor at Texas Western College, El Paso, Texas. From 1951-53 Mr. Hillhouse was employed in the geophysical department of Shell Oil Company in Alberta. He spent the summers of 1954 and 1955 doing stratigraphic work for the same company in the Northwest Territories. He spent the summer of 1956 doing field work in southwestern British Columbia for the Geological Survey of Canada and the British Columbia Academy of Sciences and the summer of 1957 doing stratigraphic work for Pan American Oil Corporation in the southern Canadian Rockies.

"Geology of the Clifton Forge Iron District, Virginia," by Frank G. Lesure has been published as Bulletin No. 118 of the Engineering Experiment Station Series of the Virginia Polytechnic Institute publications. The bulletin, accompanied by a 42 x 56-inch colored geologic map, may be procured from the Director, Engineering Experiment Station, Blacksburg, Virginia.

B. N. Cooper was a Distinguished Lecturer for the American Association of Petroleum Geologists during April and May, 1957. He lectured on "Appalachian Folding, A Control of Paleozoic Sedimentation in the Appalachian Geosyncline" before 27 affiliated societies and university departments of geology from coast to coast. On September 13, he spoke before the Illinois Geological Society meeting jointly with the Indiana and Western Kentucky Geological societies at Mt. Vernon, Illinois. On October 25, he gave his AAPG lecture at the annual meeting of the Kentucky Geological Society in Lexington, Kentucky. During 1957, he has served as a member of the VALC Committee on Water Resources and as chairman of the sub-committee on ground water.

Bruce W. Nelson attended the Sixth National Clay Conference held in Berkeley at the University of California, August 19-23, 1957. On October 19-20, he took 9 of the Virginia Polytechnic Institute graduate students in sedimentation to the York River area to study erosion and transportation in the headwaters and deposition in the estuary. He is currently studying sedimentation in this area in connection with a research project under the auspices of the Virginia Engineering Experiment Station.

The official opening of the new Virginia Polytechnic Institute Field Station was an "Open House" held on July 14, 1957, which was at-

tended by approximately 250 persons. The Station was erected by the Olin Mathieson Chemical Corporation for the Virginia Polytechnic Institute Department of Geological Sciences. Part of the furnishings of the building was donated by several Virginia mineral industries and public utilities. The Station is located on a hill overlooking Broady Bottom Bend on the North Fork of the Holston River. The building contains 3,200 square feet of floor space with provision for 24 students and 3 staff members. The building includes a large fully-equipped kitchen and a dining-lounge area. Students from three schools took the regular field course between June 15 and July 28, and thereafter, a few students continued to work on special or thesis problems dealing with the local geology.

The Virginia Polytechnic Institute Department of Geological Sciences has been loaned a Frost gravity meter through the courtesy of Dr. G. P. Woollard of the University of Wisconsin. C. E. Sears of the Virginia Polytechnic Institute Department of Geological Sciences has begun a gravity survey of southwestern Virginia.

The current program of the Geologic Division of the U. S. Geological Survey in Virginia includes the following projects. Geologic field investigations with L. D. Harris in charge are being completed in the Stickleyville quadrangle in northeastern Lee and western Scott counties. The studies of the stratigraphy and structure of this complex area are designed to provide further data that are needed to appraise the oil and gas potential of the area. Studies by J. T. Hack and others are now underway in the Potomac River basin that are primarily concerned with geomorphic processes in the watershed. The purpose is to provide basic data in the evaluation of hydrologic concepts and to test the use of certain hydrologic principles as aids in the study of land forms. Currently the studies are concentrated on the soils and other surficial deposits in the Shenandoah Valley, and a map is being prepared to show the different kinds of weathered debris of that part of the watershed. A paper on the origin of the meanders of the Shenandoah River is now being prepared by Mr. Hack in collaboration with R. S. Young. Studies are also in progress of a cross-sectional area through the southern Appalachian folded belt, including the extreme southwest tip of Virginia. J. G. Stephens is in charge. The work includes detailed geologic mapping, subsurface and geophysical investigations. This project is part of a plan to develop an integrated picture of the stratigraphy, tectonic history, and interrelationships between the Cumberland Plateau, the southern Appalachian folded belt of southwestern Virginia and northeastern Tennessee, and the Blue Ridge and Piedmont Provinces of North Carolina. The work is designed also to gather data needed to evaluate the oil and gas potential of the southern Appalachians and provide a better understanding of the geologic setting affecting the emplacements of ore deposits that

occur in this region. An area near Galax, Virginia of about 500 square miles has recently been test flown by airborne magnetometer and radioactivity methods. The resulting data are being evaluated in an attempt to make a three fold correlation between the geology, the airborne radioactivity data, and the aeromagnetic data.

—W. D. Lowry, *Virginia Polytechnic Institute.*

PSYCHOLOGY SECTION

Professor Frank A. Geldard returned to the University of Virginia in September after a year's leave of absence in London as Scientific Liaison Officer with the U. S. Office of Naval Research. Professor Geldard arranged and chaired a symposium on military psychology in connection with the International Congress of Psychologists held at Brussels in July, and during the year he reported the research being conducted at the University of Virginia to various groups of European psychologists.

A number of psychologists participated in the 1957 meetings of the American Psychological Association in New York. Dr. Frank W. Finger delivered the presidential address before the Division of Teaching Psychology; his topic was "Toward the Improvement of Teaching." Dr. Finger also jointly authored, with Dr. L. S. Reid, a paper, "The Effect of Previous Reinforcement upon Revolving Wheel Activity during Prolonged Food Deprivation." Dr. K. E. Lloyd read a paper, "Retention and Transfer of Responses to Classes of Stimuli." Dr. W. F. Battig was chairman of a session of papers on Concept Formation, and he also presented a paper on "The Effects of Previous Experience and Information on Performance on a Word Formation Problem." Dr. F. A. Geldard participated in a smyposium featuring a report from the International Congress of Psychology, and Dr. S. B. Williams was a member of a symposium considering the topic, "Key Concepts in Psychology." Dr. F. J. McGuigan chaired a paper session on Discrimination Learning and presented a paper entitled, "A Test of the Discriminative Stimulus: Secondary Reinforcement Hypothesis."

On October 2, Dr. Allen D. Calvin spoke to the University of Minnesota Psi Chi chapter on the topic of inhibition of reinforcement.

On October 30, at a meeting of the Armed Forces-NRC Committee on Bioacoustics, Dr. Geldard read a paper on the mechanical aspects of tactual communication. At this same meeting, Dr. J. F. Hahn read a paper on the electrical aspects of tactual communication.

The Research Unit of Aging at the Veterans Administration Center,

at Kecoughtan (Hampton), was established last spring to conduct basic research in the psychology of aging and to investigate chronic illnesses as psychological phenomena. The staff consists of Dr. Neil W. Coppinger and Dr. Rayford T. Saucer.

Several institutions report additions to their staff. The University of Richmond has appointed Dr. Jay Clark and Dr. Robert Johnston as Assistant Professors of Psychology. Dr. Harold Payne has become Chief Psychologist at the Memorial Guidance Clinic, and Dr. Robert Gibby is now Chief Psychologist at McGuire Veterans Hospital. Dr. Paul J. Woods has joined the staff at Hollins College, and Mr. William Buckley has been appointed to the Psychology Staff at Eastern State Hospital.

—John K. Bare, *College of William and Mary.*

STATISTICS SECTION

Dr. Ralph A. Bradley, Professor of Statistics at the Virginia Polytechnic Institute was elected a fellow in the American Statistical Association at the 1957 annual meeting at Atlantic City, New Jersey. He was also appointed Acting Editor of Biometrics and is in the process of moving the Office of Biometrics from Ottawa, Canada to the Virginia Polytechnic Institute.

Dr. John E. Freund and Dr. R. L. Wine have resigned their positions in the Department of Statistics of the Virginia Polytechnic Institute to accept positions at Arizona State College; Tempe, Arizona and Hollins College; Hollins, Virginia, respectively.

The Department of Statistics of the Virginia Polytechnic Institute has the following new members:

1. H. A. David, Professor of Statistics, received his Ph.D. degree from the University of London.
2. John Hemelrijk, Visiting Professor, received his Doctor of Science degree from the Municipal University of Amsterdam, Holland.
3. David C. Hurst, Associate Professor, received his Master of Science degree from North Carolina State College and is completing his requirements for his Ph.D. degree this fall.
4. Leroy S. Brenna, Assistant Professor, received his Master's degree from Kansas State College.
5. James R. Duffett, Assistant Professor, received his Master's degree from the University of Florida.
6. William A. Glenn, Assistant Professor, received his Bachelor of

Arts degree from the University of New Brunswick, Canada.

The Mountain Lake Conference on Statistics sponsored by the Department of Statistics of the Virginia Polytechnic Institute and the Southern Regional Education Board was held August 22-27, 1957. Approximately fifty scientists enjoyed an outstanding program. At the time of these meetings, the Committee on Statistics of the Southern Regional Education Board also held its business meeting.

The Department of Statistics of the Virginia Polytechnic Institute received a grant from the Public Health Service for a cooperative training program in conjunction with the Medical College of Virginia to train statisticians. The Department of Statistics was also awarded a contract to make an Analytical Index for the journals of the American Statistical Association covering Volumes 35-50 from the years 1940 to 1955.

A. E. Garratt, Leo Lynch, and Robert N. Pendergrass have fulfilled their requirements for their Ph.D. degrees in Statistics. Dr. Garratt is now with Telecomputing Corporation in New Mexico; Dr. Lynch is with United States Steel Corporation in Monroeville, Pennsylvania; and Dr. Pendergrass is teaching at Radford College, Radford, Virginia.

Mr. Jonas M. Dalton and Miss Beverly Anne Wales have fulfilled their requirements for their Master of Science degrees in Statistics. Mr. Dalton is now working at Bell Telephone Laboratories; Murray Hill, New Jersey. Miss Wales is teaching school on Long Island, New York.

—R. A. Bradley, *Virginia Polytechnic Institute.*